Indian Institute of Foreign Trade

SURVEY
of
INDIA'S EXPORT POTENTIAL
of
MARINE PRODUCTS

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SURVEY
OF
INDIA'S EXPORT POTENTIAL
OF
MARINE PRODUCTS

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VOLUME III

Survey of India's Export Potential of Marine Products

VOLUME III

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1. PROBLEMS OF PRODUCTION

During the field survey in India an intensive study has been made of the various problems besetting the development of the marine products industry. The various aspects pertaining to the problems as also the experiences of other maritime countries to overcome similar problems have been studied with reference to their application in Indian conditions. The most important problem faced by the export industry relates to the inadequate availability of raw material which is due to numerous factors such as the small number of mechanised boats and their concentration at a few centres, imbalance between the overall fishing fleet and the mechanised vessels, shortage of fishing vessels to undertake and exploit the off-shore and deep sea areas. Lack of ship to ship and ship to shore communications, dearth of trained technical personnel to man the fishing vessels, high cost of steel fishing vessels, deck equipment and diesel fuel in India are the other important problems. Inadequate repair and maintenance facilities and lack of refrigerated rail and road transport are some of the related problems. These problems vis-a-vis the present status of the industry are discussed in detail in the paragraphs that follow.

1.1 Fishing Craft

The right type of vessels and fishing gear form the backbone of the fishing industry. The marine industry largely depends upon the fishing fleet for its raw material supplies. Indigenous boats contribute as much as 60 per cent of the total catch in India, the remaining 30 per cent and 10 per cent accrue from mechanised boats and shore seines respectively. The indigenous boats will continue to play an important role although their total catch may not remain so significant with the introduction of more small mechanised boats and large fishing vessels. The types of indigenous crafts used by the fishermen depend upon the physical features and characteristics of the fishing grounds and, therefore, vary from coast to coast and even region to region in the same coast.

Indigenous Fishing Crafts. The present designs of indigenous fishing crafts in almost all the regions such as the north west coast comprising Kutch and Kathiawar, the Bombay coast southward to Mangalore, the Kerala coast, the Gulf of Mannar, the Palk Bay, the Coromandel coast, the Telugu coast and the Bengal coast continue to remain the same as they were hundred years ago. The northwest coast is arid and rocky with physical and climatic conditions approximating those of Arabia. Therefore, Arabian influence is reflected in the boat designs of this region. Whether the indigenous crafts are 'Kotias' or 'Machwas', the same principal characteristics can be seen in them. On the Bombay coast the same types are mingled with others, remaining Indian in origin. Southward upto South Kanara, Arab influence is replaced by indigenous and Polynesian types. The Kerala fishermen adhere to the indigenous dugout canoes. Turning to Cape Comorin, the Polynesian and indigenous boat types have held their own. The former influence is more prominent in the north-west zone of the Gulf of Mannar and is universally present in the Palk Bay. Elsewhere in this region indigenous designs of 'catamaran' and 'canoes' are well marked. North of Point Calimere is the real home of the 'catamaran', a truly Indian type and specialised for use upon the surf beaten Coromandel and northern Telugu coast. The 'catamaran' and the 'masula' boats are likely to be in vogue, wherever there are no harbours or refuge. In Bengal the small coastal crafts are variations of the Ganges dinghies.

The exact and up-to-date statistics of indigenous crafts engaged in fishing in various maritime States in India are not available. Their estimated number is, as given in Table A-I.

Table A-1

Number and Types of Indigenous Fishing Crafts in Maritime States of India 1/

State	Types of Indigenous Crafts	Number (1967-68)
Gujarat	Machwa, Lodhia	3,281
Maharashtra	Plank built burthen and small dugouts with and without out-rigger, machwa, satpati	8,382
Goa	Dug-out, Plank built Canoes	1,091
Mysore	Pattawar (plank built), Machwa, Dhoni	6,358
Tamil Nadu	Dugout, Catamaran	30,000
Kerala	Dugout, Catamaran	20,667
Andhra Pradesh	Catamaran, Masula, Nava, Shoe Dhoni	21,000
Orissa	Catamaran, Bar boat (Podhuna)	2,789
West Bengal	Batchari, Chot	108
	Total	93,676

The traditional indigenous crafts suffer from the disability of fishing in the off-shore waters and their operations remain confined to the inshore waters only.

1/ Central Institute of Fisheries Technology, Ernakulam.

This restricts the increased supply of fish from the inshore belt. The result has been that the indigenous crafts have not been able to meet the growing needs of the processing industry. Switch over to large scale mechanisation is the only solution to overcome the problems of inadequate supply of raw material to the processing sector by (a) increasing the range and duration of operation of fishing crafts, and (b) undertaking off shore fishing.

The traditional crafts such as dugout canoes, catamaran and sailing boats being popular in various areas, introduction of mechanisation in such regions presents numerous problems, principal among them being: (a) small existing crafts do not in all cases lend themselves to efficient mechanisation, (b) lack of capital with the fishermen to enable them to invest in specially designed vessels, and (c) inadequacy of landing and berthing facilities. Majority of fishermen, therefore, continue using indigenous crafts like catamarans which enable landings to be made on the open beaches. With the development of the necessary infrastructure for the fishing industry, the implementation of the programme of craft mechanisation and introduction of vessels for off shore and deep sea fishing has necessarily to be achieved in three phases - (i) motorisation of country craft and introduction of small mechanised boats, (ii) introduction of large and more specialised vessels; and (iii) broadening into fishing fleet with partial processing at sea.

Mechanisation of Fishing Fleet

a) Small Boats. In the more advanced countries fishing fleet has been mechanised and improved. The developments have been spread over a period of several years leading to the evolution of many distinct types of crafts, each suited to a particular fishery. The initial efforts in almost every fishery were made with hand or sail propelled crafts. Subsequently, steam and gasolene power were introduced, diesel engine being the latest as the standard prime mover for fishing vessels. Very little of these developments have been the outcome of deliberate planning. The development of the various fisheries to meet the increasing demand, however, led to the improvements and modifications in the designs and the layout of the fishing accessories.

The motorisation of the indigenous craft as the first step in the introduction of fully mechanised fishing is best suited to 'Lodhias' and 'Machwas' in Gujarat coast, Satpati/Versova boats in Bombay, Tuticorin boats in Gulf of Mannar, Andhra 'Nava' in Telugu coast and

'Batchari' in Bengal coast. The credit for initiating craft motorisation in India goes to the State of Maharashtra where Satpati/Versova boats were first successfully motorised. The States of Tamil Nadu, Kerala, Andhra Pradesh and Gujarat which now have a large number of small mechanised boats were the next to follow.

Mechanisation was initially introduced during the First Five-Year Plan, when about 650 mechanised boats were commissioned. The number of such boats rose to about 2,000 at the end of the Second Plan. As against the Third Plan target of 4,000 mechanised boats, only 2,500 could be introduced, owing to the difficulty in obtaining the required number of marine diesel engines. While the number of mechanised boats introduced in various maritime States during the Second and Third Plan periods and afterwards is indicated in Table A-2., their size-wise distribution as on 31st March 1969, appears at Annexure I-A.

Table A-2

Number of Mechanised Boats Introduced in India [2/]

State/Union Territory	End of 2nd Plan	End of 3rd Plan	1966-67	1967-68	1968-69
Gujarat	461	1,433	46	130	130
Maharashtra	338	1,881	201	180	168
Mysore	48	226	100	135	115

Contd..

Source: Ministry of Food, Agriculture, Community Development and Co-operation, New Delhi.

Table A-2 (contd.)

State/Union Territory	End of 2nd Plan	End of 3rd Plan	1966-67	1967-68	1968-69
Kerala	136	822	216	250	274
Tamil Nadu	82	477	154	170	200
Andhra Pradesh	66	193	21	26	30
Orissa	5	47	25	25	60
West Bengal	4	9	-	-	-
Laccadives	10	41	4	20	26
Andamans	3	5	-	-	-
Goa	-	54	28	8	-
Pondicherry	8	18	5	3	5
Total	2,161	5,206	800	947	908

On the basis of the available estimates relating to catch per square kilometer of inshore area, and average catch of each type of mechanised boat in the different potential regions, the requirements of machanised boats upto 15 kms work out to 19,271 at the end of the Fourth Plan, as given in Table A-3.

Table A-3

Requirements of Mechanised Boats at the end of the Fourth Plan 3/

State/ Union Territory	Potential (Tonnes)	Percentage Contribution of Shore Seines	Potential for Boats (Tonnes)	Average assumed catch from Mechanised Boats (Tonnes)	No. of Boats Required
West Bengal	17,757	Nil	17,757	45	395
Andhra Pradesh	101,964	15	86,669	45	1,926

Contd..

3/ Source: Report of the Working Group on Fisheries, Fourth Five-year Plan.

Table A-3 (contd.)

State/ Union Territory	Potential (Tonnes)	Percentage Contribution of shore Seines	Potential for Boats (Tonnes)	Average assumed catch from Mechanised Boats (Tonnes)	No. of Boats Required
Tamil Nadu Pondicherry	161,644	15	137,397	45	3,053
Kerala	333,076	1	319,745	50	6,595
Mysore	78,650	65	27,527	50	550
Goa	8,920	5	874	50	169
Maharashtra	131,997	5	125,312	50	2,506
Gujarat	207,280	3	201,062	55	3,655
Andamans	10,000	Nil	10,000	45	222
Laccadives	10,000	Nil	10,000	50	200
Total	1,061,198	109	953,943		19,271

As against the requirements of 19,271 mechanised boats by the end of 1973-74, the mechanisation programme for the Fourth Plan envisages an addition of about 5,500 to the existing fishing fleet of about 7,700 raising the total number to about 13,500. The distribution of these mechanised boats during the Fourth Plan in the different States is given in Table A-4.

Table A-4

Mechanisation Programme for the Fourth Plan 4/

State/Union Territory	No. of Boats (1973-74)
Andhra Pradesh	200
Gujarat	1,100
Kerala	1,325
Tamil Nadu	1,000
Maharashtra	900
Mysore	510
Orissa	31
West Bengal	-
Andamans	76
Goa	200
Laccadives	112
Pondicherry	80
Total	5,534

4/ Source: Report of the Working Group on Fisheries, Fourth Five-year Plan.

The above figures relate to the small sized boats of less than 15 m in length. Besides small boats, emphasis is now shifting on the introduction of deep sea fishing by commissioning larger vessels. A beginning in this direction has been made by private enterprise in Kerala and Maharashtra, which has introduced a few vessels of over 15 m O.A.L.*

b) Medium and Large Fishing Vessels. In the initial years of the introduction of mechanised fishing boats, the emphasis was on small sized boats ranging from 6 m to 12.2 m mainly due to low initial investment. There are at present about 30 steel fishing vessels of sizes ranging from 16.6m to 22.6m engaged in commercial and exploratory fishing. There is a proposal to introduce about 300 steel vessels in the size range of 15.2m to 30m during the Fourth Plan, as indicated in Table A-5. The introduction of larger vessels of more than 30m length can only be envisaged after a thorough investigation of the deep sea areas has been completed.

Whereas the number of mechanised boats at the end of the Fourth Plan will not be sufficient to exploit the estimated potential, the criteria of planned introduction

---

* O.A.L. = Over All Leangth

Table A-5

Distribution of Medium & Large Vessels in the Various States During Fourth Plan 5/

State	Size of Vessels		Total Number
	15.2m - 18.1m	27.5m - 30m	
Gujarat	12	6	18
Maharashtra	40	10	50
Mysore	30	5	35
Kerala	60	20	80
Tamil Nadu	60	20	80
Andhra Pradesh	20	2	22
Orissa	5	-	5
Union Territories	5	5	300
Total	232	68	300

of (i) more of small mechanised boats in areas which remain comparatively unexploited, and (ii) more of medium as well as large vessels to exploit off shore fishing grounds and less number of small vessels in areas where intensive fishing activity has taken place in the inshore belt, will yield better results. It is also necessary to relate the number of vessels to be introduced in different maritime States to the phased programme of providing the landing and berthing facilities. Based on these considerations, the Survey recommends the introduction of 3162 small vessels, 295 medium vessels and 103 large vessels according to the following distribution. (Table A-6)

5/ Source: Report of the Working Group on Fisheries, Fourth-Five-year Plan.

Table A-6

Centre-wise Distribution of Proposed Fishing Vessels by the End of 1978-79 6/

(Numbers)

Centre	11.1 m	13.8 m	17.5m	22.0m	27.3m	Total
Kandla	--	-	-	4	3	7
Veraval	400	-	20	10	-	430
Bombay	250	-	44	14	7	315
Ratnagiri	240	-	-	-	-	240
Marmugao	75	-	-	-	-	75
Karwar	35	9	6	-	-	50
Malpe	150	18	12	-	-	180
Cochin	-	-	21	14	20	55
Vizhinjom	400	-	18	14	18	450
Tuticorin	400	-	20	10	20	450
Madras	500	-	20	10	20	550
Visakhapatnam	60	-	30	-	10	100
Kakinada	100	-	-	-	-	100
Chandnipal	150	-	-	-	-	150
Roychauk (near Haldia)	75	-	9	9	-	93
Port Blair) Diglipur) Katchall)	100	-	10	-	5	115
Minicoy	200	-	-	-	-	200
Total	3,135	27	210	85	103	3,560

6/ Source: IIFT Survey Team.

While all the 3162 small mechanised boats (11.1 m and 13.8 m) have been recommended for introduction during the Fourth Plan, phasing of the proposed 398 medium and large vessels including 60 vessels suggested for import (17.5 m to 27.3 m) has been extended upto 1978-79 as indicated below:

Table A-7

Proposed Introduction of Medium and Large Vessels [7]

Size of vessel	1970-71	1971-72	1972-73	1973-74	1978-79
17.5m (57 ft)	40	45	60	63	-
22 m (72 ft)	15*	20*	10*+5	10	25
27 m (88 ft)	5*	10*	20	25	43
Total	60	75	95	100	68

Research Vessels. It has recently been decided to place orders indigenously for the construction of a 48m modern research vessel. This vessel is required to serve the following fishery research disciplines and is designed to undertake stern trawling, purse seining and long lining:

---

* To be imported (including those under joint ventures)

[7] Source: IIFT Survey Team.

a) Fishery biological research

b) Technical research on fishing gear and equipment, and

c) Technological research on fish processing.

One research vessel of 31.7m length, selected by a technical mission to Europe in 1966 has been acquired in March 1970 from a yard in the German Democratic Republic. This trawler is fitted with 525 BHP engine and part of its fish-hold is refrigerated. The vessel is equipped to carry out exploratory operations in the Bay of Bengal. Another vessel of the same length but of a French design is also likely to be ordered for undertaking comparative studies on the efficiency of both types of vessels, in respect of the fishing gear, potential of fishing grounds and location of new grounds in the deep water area.

Two 21.7m purse-seiners at present at the designing stage in the Government of India, Deep Sea Fishing Organisations's Design Wing, are to be added to the fleet for undertaking investigations on pelagic fisheries of the east and west coasts.

The acquisition and operation of these research vessels and the 40 steel vessels of 17.5m length under construction in the country should be utilised to furnish information about the fishing grounds and data for standardisation of the size and type of fishing vessels for large scale commercial fishing operations.

c) Factory Vessels. Japan, Spain, Poland, UK and Canada have been increasing the sizes of their vessels with the introduction of factory vessels to cover distant areas and to land fully processed or semi-processed products. The distant water fishing has been taken up in the European countries on account of inadequacy of fish in the near water areas caused by the concentration of effort in many countries. Most of these vessels fish on the north east and north west Atlantic and to a limited extent only in the south east. Some of the countries like Japan, Spain and Poland have made a success of factory vessel operations in view of better price realisation from the landings and semi-processed or processed products. In India, the introduction of very large fishing vessels and factory vessels has to be viewed from their economic operations, and therefore there is need to be cautious in the introduction of such vessels from India bases at present particularly on account of the proximity of rich fishing grounds.

Boat Building

In the initial stages of the introduction of mechanisation, the target for the construction of mechanised boats could not be reached for want of adequate boat building capacity. This position has considerably improved during the last decade. Many new boat building yards have been established in the principal maritime States, like Kerala, Tamil Nadu, Mysore, Maharashtra, Andhra Pradesh and Gujarat. The total number of boat building yards in the various States and Union Territories at present stands at 83. Of these, 69 are wooden boat building yards and the remaining 14 comprise steel boat building yards. Their distribution in the various States is shown in Table A-8.

Adequate capacity exists in the country for the production of wooden boats. Information relating to capacity of each of the wooden and steel boat building yards in the public, cooperative and private sectors in the various maritime States as well as the types of boats manufactured by them appears at Annexure I-B.

Wooden Fishing Boats. While the existing capacity for building wooden boats is sufficient to meet the requirements of the different sizes ranging from 9 m. to 12.1m., scarcity of the right type of timber in certain States like Kerala and Andhra Pradesh presents problems in the construction of such boats. In other States like Tamil Nadu, there being no programme of plantation of certain species of timber and the existing resources being limited, the supply of wood for boat construction is likely to pose a problem in the near future. Andhra Pradesh Government have already selected some wild growing species as alternative types of material wich have yet to be tested.

Table A-8

Number of Boat Building Yards in India[8/]

State/Union Territory	Total	Govt	Owned	Corporation		Cooperative		Private	
		Wooden	Steel	Wooden	Steel	Wooden	Steel	Wooden	Stee
Gujarat	9	-	-	-	-	5	-	4	-
Maharashtra	11	-	1	-	-	2	-	5	3
Goa	1	-	1	-	-	-	-	-	-
Mysore	9	2	-	-	-	3	-	4	-
Kerala	27	1	-	4	-	1	-	20	1
Laccadives	1	1	-	-	-	-	-	-	-
Andhra Pradesh	1	1	-	-	-	-	-	-	-
Tamil Nadu	7	4	-	-	-	1	-	2	-
Orissa	4	-	-	1	-	1	-	2	-
Punbjab	3	-	-	-	-	1	-	2	-
West Bengal	10	1	3	-	-	-	-	1	5
Total	83	10	5	5	-	14	-	40	9

Wooden Boat Building Yards: 69
Steel Board Building Yards: 14

8/ Source: Central Institute of Fisheries Technology, Cochin.

Copper is another scarce and costly material that goes into the manufacture of wooden boats. On the basis of experiments carried out by the Central Institute of Fisheries Technology, it has been suggested that aluminium alloy sheathing could be an effective and cheaper substitute for copper. This suggestion has not so far met with success. Recent experiments made to use fibre glass in place of copper have yielded encouraging results though the operational merits and demerits of the material have to be studied for conditions prevailing in the country.

Steel Vessels. Currently, 40 steel vessels of 17.5 m length are under construction in the different ship building yards in the country. For constructing these vessels, the design and plans were developed in 1966-67 on the basis of the experience of operation of a 17.5 metre shrimp trawler by the Deep Sea Fishing Organisation. Specifications of this trawler are given at Annexure I-C. The experience and technical knowledge of the various ship yards and Fishery Experts were utilised to evolve a satisfactory design for construction of this type of vessel on a large scale, for which two consortia have been formed, one on the west coast and another on the east coast. These consortia consist of :-

West Coast

Mazagaon Dock
M/s Scindia Boat Building Yard
M/s Alcock Ashdown and Co.
Goa Ship Building Yard
Brunton and Engineers Ltd.

East Coast

Garden Reach Workshops
Port Engineering Works
River Steam Navigation Company
Shalimar Engineering Works
Andrew Yule and Co.
Hoogly Docks Engineering Co.
West Bengal Engineering Co.

M/s Mazagaon Dock Ltd are acting as a coordinator for the west coast consortia and have taken a consolidated order for the construction of 20 vessels. On the east coast, orders for the construction and supply of another 20 trawlers have been placed separately on each of the seven boat building yards. These trawlers are being fitted with identical machinery and equipment like Kirloskar/MAN engines, winches, Furuno fish finders and radio telephones. Delivery of these vessels is scheduled to be completed by early 1970.

Steel fishing trawlers are being constructed by the boat building yards in such a large number in the country for the first time for the institutions belonging to the Central and State Governments. The demand for such trawlers from the commercial interests will be determined on the results of the fishing trials and the cost on which they could offer these vessels on deferred payment basis. It has taken nearly four years to develop design to draw its plans and construction details and to produce a vessel for fishing trials in September 1969. It will take some more time before it could be tested and improved to suit the actual operational conditions before being made available at reasonably low cost for commercial fishing operations. In the meantime it is necessary for the boat building yards in India to undertake the following measures:

i) concentrate on effecting improvements in the design of these vessels to achieve greater efficiency;

ii) specialise in the construction of one or two types of vessels in the early stages; and

iii) bring down the cost of production.

While specialisation and improvement in the design of these vessels will help in the reduction of constructional cost to some extent, phased programme of supply on deferred payment terms with the grant of subsidy by the Government to the extent the cost of indigenous vessel is higher than the international price, as mentioned elsewhere in this Report, will attract the commercial fishing enterprises to go in for this type of vessel. Till such time the cost is brought down to the level of international prices, the Government should subsidise the vessel for commercial fishing operations. With these steps it would not be long before the ship building yards in India could not only meet all the requirements of the fishing industry in the country for this size of vessel but also plan to undertake export to the neighbouring countries.

USA and Mexico. In USA and Mexico shrimp trawlers have been designed and constructed on a large scale during the last 15 years. One of the boat building yards (Rysco) in Rockport has been specialising only on shrimp trawlers since 1960, having launched its 200th shrimp trawler in February, 1969. The yard supplies its vessels to most of the operators in Gulf States, Central and South America, West Africa, Kuwait, Japan and Australia.

Another boat building yard in Mexico which specialises in the construction of shrimp trawlers has constructed 450 trawlers during the last 25 years. This yard has also supplied its vessels to Central and South America, Kuwait, Korea, Japan and Pakistan, besides meeting the requirements of the Mexican shrimp industry. In Mexico import of fishing boats was allowed from 1945 to 1955. Three boat building yards specialising in construction of shrimp trawlers were established in 1944. When the boat building yards in Mexico could supply shrimp trawlers of the required speciafications at competitive rates, the import was banned. In fact these three yards in Mexico are now in a position to meet the orders not only from the fishing industry in Mexico but also supply trawlers to foreign countries. Some of these boats intended for export get the items of equipment of choice by the foreign indentors on duty free basis and supply them at reasonable costs.

Mexico, the largest exporter of shrimp today is concentrating its boat building on shrimp trawlers of over 19 m overall length. These vessels are fitted with 300 to 500 BHP engines and have recently incorporated the brine chilling system for semi-processing of the product at sea to obtain a quality product and a better export value.

Some of the ship yards in the Southern States of USA have specialised in the construction of shrimp trawlers. They are in a position to supply these vessels at competitive rates and on deferred payment terms. The cost of shrimp trawlers constructed in Mexico, Texas, Florida, etc. are so attractive in view of their cost and quality that they are supplying them to many parts of Asia, Africa and South America. They have also supplied shrimp trawlers to Japan, Germany and Australia. This reduction in cost has eliminated the subsidy provided earlier to fishermen in USA for shrimp vessels.

Discussions with FAO experts and those engaged in commercial fishing in United States and Mexico as also the Japanese companies operating in South America and Central America, revealed that the designs of shrimp trawlers developed by USA and Mexico have proved to be the best. It is, therefore, necessary to appreciate the importance of experience and the need for construction of good shrimp trawlers at competitive prices by developing the programme in a phased manner. The general specifications of the three types of shrimp trawlers (60', 72' and 85') construsted in these yards and recommended for adoption in India are given at Annexure I-D.

Poland. Poland also occupies an important place in the production of fishing boats. The Polish ship building yards have specialised in factory trawlers and freezer trawlers besides one or two types of small fishing trawlers (Storem 8 and T.R.27). General specifications of these two types of fishing trawlers (17.6 m. and 27.5 m) are given at Annexures I-F&F They have supplied the factory trawlers of specific designs to USSR and some of the East European countries besides their own State fishery enterprises. They have supplied fishing trawlers of 27 m. and 17 m. to France, Norway, West Africa, UK, Greece, Mexico, Ceylon, Pakistan, Libya, Burma and Kuwait. The large scale manufacture of fishing trawlers in Poland has been made possible by restricting the production to specialised vessels and this arrangement has enabled them to compete in international market both in terms of value and quality. Similarly the GDR and some of the other countries of Europe like Holland, Norway, France and Spain have specialised in one or two types of fishing vessels. General specifications of the GDR fishing trawler of 24.47m length are given at Annexure I-G

Design Development

With regard to the production of large steel fishing vessels, their designs have yet to be developed in India. The immediate need is for special design for shrimp trawling and ground fish trawling. Shrimp trawlers of the sizes 22 m and 24.8 m. have been developed in the Gulf of Mexico and they are used for fishing in that region on a large scale by different countries. Based on the operation of these vessels some of the countries like Mexico, Venezuela and Panama have taken steps to get these vessels constructed indigenously with the assistance of experienced boat builders over a period of time. In fact Mexico had permitted import of fishing vessels for 10 years, from 1945 to 1955, from the United States and operation by charter or the joint ventures with US Fishing Companies in that region.

Such a development calls for not only purchase of certain designs but also the experience of operating those vessels from Indian bases. It will be appropriate to suggest that 6 units of each type of shrimp trawlers should be permitted to be imported by fishing companies organised in India either on their own or as joint ventures in three or four regions. If they are procured under joint ventures, it should be possible to consider chartering of the shrimp trawlers for a period of 2 to 3 years with the option of either purchasing them outright or by returning them later, when adequate number of similar types are built in the country. This experience on the operation of these types of trawlers for a period of 2 to 3 years would definitely lead to a healthy development of designs in the country to suit the specific needs of the fisheries in India. It will also be possible to plan a gradual phasing of programme of operation by the Fishing Companies and construction by the boat building yards.

Simultaneously, the experimental and exploratory fishing organisations of the Government of India and the Central Marine Fisheries Research Institute engaged in the exploratory surveys of the fishing grounds should undertake experimental fishing with different sizes of boats in different regions. These institutions should also be permitted to bring in two prototypes of each type of fishing vessels for this purpose.

Fibre Glass and Concrete Boats. Reinforced fibre glass and ferro-cement are gaining popularity in the construction of fishing vessels. Successful experiments in this field by South Africa are being followed in Japan, Poland, Norway and the U,S.A. Though the cost of the vessel is higher than the conventional wooden vessel, the life of the vessel is reported to be far in excess to that built of wood. The maintenance and up-keep of a fibre glass vessel is stated to be negligible and it has claimed that the life of the hull can exceed that of even the steel vessel. In the U.S.A. a 21.8 m. fibre glass vessel having 6 m. beam and 2.7 m. depth constructed in a seamless design was recently completed for shrimp operations at a cost of Rs 577,000 excluding the cost of the winch and fishing gear. It is reported that a hull can be constructed in 18 days and delivery effected within 90 days. There is no deterioration by way of rust, electrolysis and no dry rot or marine borers to contend with. Besides, complete water tightness is guaranteed in the heaviest of weather. The ballasting problems due to the low specific gravity of the material has been solved by having the keel 'moulded-in' with pre-stressed concrete having a weight of three tonnes.

A beginning has been made in India in the manufacture of small fibre glass boats and it is suggested that prototype of one or two proven designs be introduced for experimental purposes. A start could be made with the 13.8 metre design of the Central Institute of Fisheries Technology. Manufacture of one piece would present difficulties as the cost of the mould and core would not enable the manufacturer to produce the vessel at a price competitive to that made of wood. It was reported that a minimum order of 10 would reduce the price considerably.

In countries where shortage of wood is posing a problem in the construction of fishing vessels, the introduction of ferro-cement for hull construction is under way. Ferro-cement hulls have the advantage of being cheap, strong and take less time in construction. Besides, their maintenance costs are low and repairs can be carried out easily. Recently the Government of Hong Kong assisted some fishermen with the construction of a ferro-cement fishing boat by advancing a loan of HK$ 95,000, representing 80% of the total cost of the vessel including fishing gear, engines and initial operating cost. In Thailand a 15.5 metre ferro-cement vessel was recently commissioned and is undergoing trials and testing. It is recommended that designs of ferro-cement hull may be obtained and their proto-types built for adoption in Indian conditions by the Central and State Departments.

Cost of Boats

India. The cost of wooden hulls with engines in various maritime States in India ranges from Rs 40,000 to Rs 225,000 depending upon the size ranging from 9.2 m to 15.4 m, H.P., cost and make of the engine. As can be seen from Table A-9., the cost of boats in Maharashtra and Gujarat is generally lower compared to cost of the same size of boats in other States. While the principal reason for the price variation is on account of the cost of the engine fitted in the boat depending on its H.P. and make, these two States have different types and designs of boats which are built of timber obtained at a cheaper rate and involve less construction cost.

Table A-9

Cost of Boats (Hull and Engine)[9]

(Rs '000)

	30' (9.2m)	32' (9.8m)	36' (11m)	40' (12.3m)	45' (13.8m)	50' (15.4m)
Maharashtra	-	57	-	75	85	-
Gujarat	48	-	70	77	-	-
Kerala	-	52	92	120	150	225
Tamil Nadu	46	54	-	-	-	-
Mysore	40	61	95	-	-	-

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[9] Source: Field Survey

The cost in the above table is exclusive of the subsidies available for the purchase of mechanised boats in various States. In some of the maritime States like Maharashtra, Kerala and Mysore subsidy is given only on the purchase of marine diesel engines and in certain others such as Tamil Nadu and Gujarat hulls are also subsidised. The financial assistance extended to the scheme for mechanisation of fishing fleet varies from State to State as follows:

State	Subsidies available
Maharashtra	40 to 50 per cent on engines
Gujarat	i) 20 per cent on hull ii) 50 per cent on engines
Mysore	50 per cent on engines
Tamil Nadu	i) 25 per cent on hull ii) 50 per cent on engines
Kerala	50 per cent on engines

There is a gradual scaling down in the quantum of subsidy in each State depending on the progress of the scheme in different regions. From 1968 onwards the loan portion is being given mostly through institutional finance such as the Agricultural Refinance Corporation (ARC) through the agency of cooperatives. The subsidy is provided directly by the State Governments or as part of the share contribution to the cooperatives.

The cost of the small mechanised boats in India cannot be compared with boats of the same size in other maritime countries because small fishing boats are not comparable to those in operation in foreign countries in view of the types of fishing like dara and lobster fishing. In view of the fact that the number of small mechanised boats in India has already expanded, the grant of subsidy on such boats should be left entirely to the concerned States.

The construction of steel fishing vessels in India has started only recently, and the cost of the 40 steel fishing vessels of 17.5 m length fitted with indigenous marine diesel engines now under construction is Rs 875,000 per vessel. These vessels are meant for experimental and exploratory fishing by the Central and State Government Organisations. It is understood that the Government of India have taken a decision to offer 25 per cent subsidy for inducing private operators to go in for these large vessels. The cost of this vessel is likely to be reduced to Rs 750,000 when the production is stepped up to meet the commercial requirements originating from the fishing industry. The survey revealed that the similar sizes of steel fishing vessels in other countries are comparatively much cheaper.

Comparative Cost in Other Countries. From the offers recently made by some of the foreign countries for the supply of fishing trawlers ranging in size from 16 m to 31.7 m with engines of suitable horse power, as can be observed from the Table A-10., the shrimp trawlers from Mexico, USA, Spain and Japan are most reasonably priced. The ship yards from Mexico and USA offer easy payment terms with quick deliveries compared to Spain and Japan. The offer of the Spanish boat building yards is subject to the condition of placing bulk orders for 10 vessels at a time, terms of payment being cash, without the deferred payment facility.

Trawlers from Mexico, USA and Japan are already being supplied to many countries for initiating programme of shrimp fishing on an intensive scale. In view of the experience and possibility of getting attractive offers for collaboration in the early phases, it is recommended that the types of vessels in Mexico and USA should form the nucleus of large vessels for the shrimp industry in the country, particularly when trawling conditions in Mexico and India are alike.

Table A-10

Comprative Cost for the Supply of Large Vessels 10/

Country	Length of Vessel	Price (Rs million)	Remarks
Poland	i) 16m-300 BHP	0.80	Trawler
	ii) 28.8m-530 BHP	2.05	Semi-refrigerated
Spain	i) 17.5m-200 BHP	0.59	Trawler
	ii) 19.7m-240 BHP	0.64	"
	iii) 22.0m-335 BHP	0.69	"
Iceland	19.6m-280 BHP	1.11	"
Mexico	20.2m-335 BHP	0.92	"
France	21.5m-360 BHP	1.64	Semi-refrigerated
USA	i) 23m-350 BHP	0.56	Trawler
	ii) 24m-350 BHP	0.58	"
	iii) 25.5m-450 BHP	0.60	"
	iv) 26.1m-525 BHP	0.65	"
Norway	21.5m-360 BHP	1.83	Trawler
Japan	22.65m	1.00	Semi-refrigerated
Sweden	28.6m-410 BHP	2.80	Training Vessel
German Democratic Republic	31.7m-552 BHP	3.25	Semi-refrigerated

Subsidy on Vessels

Based on the existing fishery resources and the potential availability in different regions, the Project Reports for various maritime States propose introduction of

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10/ IIFT Survey Team.

22m and 27m length. Introduction of fishing vessels of more than 30 m in length may be deferred till investigations by the CMFRI and DSFO beyond 60 fathoms indicate the deep seas to be richer for economic operation of large vessels. Financial assistance in the form of loans and subsidies will, however, be needed to induce and encourage the fishing companies/corporations to acquire large vessels for their operations. The extent of subsidies for medium and large fishing vessels will be to meet the price differential between the cost of construction of such vessels in the country and their international prices. The estimated quantum of subsidy for large vessels will be as given in Table A-11.

Table A-11

Amount of Subsidy for Fishing Vessels [11]

(Value: Rs million)

Number & Size	Estimated cost in India	International price	Difference (Subsidy)
210 Trawlers of 17.5m OAL	210 x 0.905 = 190.05	210 x 0.525 = 110.25	79.80
40 Trawlers of 22 m OAL	40 x 1.87 = 74.80	40 x 0.636 = 25.44	49.36
88 Trawlers of 27 m OAL	88 x 2.8 = 246.40	88 x 2.1 = 184.80	61.60
Total	511.25	320.49	190.76

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[11] Source: IIFT Survey Team.

The amount of Rs 190.76 million being the difference between the estimated cost of 338 large fishing vessels in India and the international prices recommended for allocation as subsidy does not include the foreign exchange component of Rs 60.12 million representing the cost at international prices of 60 vessels suggested for import elsewhere in this Report. The 60 vessels recommended for import comprise 45 number of 22 m size costing Rs 28.62 million and 15 number of 27 m. size valued at Rs 31.5 million. The total amount of subsidy and foreign exchange involved for the introduction of 398 medium and large fishing vessels comes to Rs 250.88 million. The subsidy on fishing trawlers constructed in the country should be considered as subsidy to the ship building industry and not to the fishing industry.

Marine Diesel Engines

Five firms have been licensed to manufacture marine diesel engines in the country. Although they manufacture marine engines against specific orders placed on them by the fishing industry, they are mainly engaged in the production of industrial engines which are being converted for marine use, except 'Kelvins'. The details of their overall annual licensed capacity, orders received from the fishing industry for marine diesel engines and the supplies effected during the last two years are given below:

Table A-12

Production of Marine Diesel Engines[12]

(Numbers)

Name of the Firm	Make & H.P.	Total Annual licensed Capacity	1966-67 Orders received	1966-67 Orders executed	1967-68 Orders received	1967-68 Orders executed
M/s Premier* Automobiles	"Meadows" 54 H.P.	3,000	60	50	34	7
M/s Ruston & Hornsby Ltd	"Ruston"	720	267	111	130	87
M/s Kirloskar Oil Engines Ltd	"Kirloskar" MAN/Cummins 10-40 H.P.	180	24	15	22	22
M/s Alcock Ashdown Co. Ltd	"Kelvin" 33 & 34 H.P.	225	133	133	62	58
M/s Lakshmi Narathan Engg. Works Ltd.	"Lister" 18 H.P.	142	30	12	-	-
Total		4,267	514	321	248	174

* Mainly manufacture automobile engines which are converted into marine diesel engines according to the orders from the industry.

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[12] Source: Boats and Crafts Committee Report, Ministry of Industrial Development, New Delhi-

As against the total orders placed by the fishing industry for the supply of marine diesel engines in 1966-67 and 1967-68, the orders executed represent 62 per cent and 70 per cent respectively of the requirements. This is indicative of the fact that the existing production capacity of the firms is insufficient to meet the demand and specific requirements of the marine diesel engines for the fishing industry. The supply position of the marine diesel engines is likely to become acute during the Fourth Plan when about 6,000 mechanised boats are proposed to be added to the existing fleet. The estimated requirements of indigenous and imported engines during the next five years are as follows:

Table A-13

Estimated Requirements of Marine Diesel Engines During the Fourth Plan[13]

Year	Total	Indigenous	Imported
1969-70	750	559	191
1970-71	938	710	237
1971-72	1,125	838	287
1972-73	1,500	1,125	375
1973-74	1,687	1,277	410
Total	6,000	4,500	1,500

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[13] Source: Working Group on Fisheries, Fourth Five Year Plan.

Of the estimated requirements of 6,000 marine diesel engines in the country during the Fourth Plan, as can be seen from Annexure I-H, 3,000 engines will be required in the range of 50 to 140 H.P. On the assumption that all the imported engines will range between 50 and 140 H.P., most of them being above 75 H.P., the existing indigenous capacity will need to be expanded to meet the requirements of the remaining 1,500 engines. Till such time adequate capacity is built up, it is recommended that the import of low revolution engines in the range between 50 and 140 H.P. be liberalised.

Performance of Indigenous Engines. The manufacturers had begun production of marine diesel engines from 1962 onwards and it has taken about 5 to 6 years before M/s Ruston and Hornsby Ltd. improved their engines to meet the specific requirements of the fishing vessels of different sizes and functions. The process of improvement is still going on. The performance of marine engines manufactured by Kirloskar Oil Engines Ltd. had not been favourably received by the fishing industry and the firm was not in a position to meet the special requirement of the industry till very recently. M/s Alcock Ashdown Co. Ltd. is the only firm with an annual manufacturing capacity of 225 units engaged in the production of marine diesel engines of 1,000 RPM of 33 and 44 horse power. Kelvin engines were supplied to fishing boats in Mysore, Kerala and Tamil Nadu in 1968 & 1969 and there were complaints from a large number of operators of defective reverse/reduction gear boxes after a short period of fishing operations under load. Even though the firm responsible for the manufacture had agreed to rectify the gear boxes, this situation had created a setback in the demand for these engines. The fishermen have lost active fishing days and also earnings from the boats causing certain amount of distress with regard to the repayment of loan and interest. This indicates the need of constant endeavour to improve the quality and performance of indigenous marine diesel engines by the manufacturers. It is necessary to appreciate the specific requirements of fishing vessels as distinct from port barges, tugs and ferry-boats. Although one or two manufacturers had taken active steps in this regard, it had taken about 6 to 7 years before engines could be brought to the level of specific requirements of fishing vessels.

Other firms manufacture high revolution engines for industrial units capable for conversion for marine use and the existing capacity is adequate for such high RPM (revolution per minute) engines. For trawling, fishing industry has preferred marine diesel engines with 1,000 RPM maximum, ranging from 50 to 140 H.P. and about 50 per cent of the requirements are for these types. It will be observed from Table 10 that only one firm is engaged in the production of engines having 1,000 RPM maximum and meets part of the requirements of 33 and 44 H.P. engines.

Cost of Engines. The cost of the indigenous marine diesel engines is relatively high compared to the cost of imported engines. For instance, the price of an imported "Torpedo" engine of 34/58 H.P. with 2 to 1 reduction gear ratio is about Rs 13,000, "Yanmar" diesel engine of 33 H.P. Rs 13,895 and "Bukh" engine of 40/51 H.P. with the same reduction gear ratio is Rs 15,700. The indigenous marine diesel engines like Kelvin of 33 and 44 H.P. cost about Rs 28,000 and Rs 36,000 respectively and Ruston with the same specification costs about Rs 30,000. As can be seen from the Table A-14., the difference between the prices of indigenous and imported engines in certain cases is as high as 100%. The high cost of indigenous engines ultimately affects the cost of production of the finished products.

The international cost of marine diesel engines of the fishery industry averages Rs 575 per h.p. whereas the same in India works out to about Rs 830 in the 33/87 range and to Rs 780 in the 90/200 range. The price to the fishing industry in the U.K. works out to Rs 680 per h.p. in the low h.p. range and to Rs 500 per h.p. in U.S. A. for the 350 and 525 horse power. In view of this the manufacturers of marine diesel engines in the country should bring down the cost of production to the level of the international cost besides improving the quality of their products.

Table A-14

Cost of Indigenous and Imported Engines 14/

Name of Engine	Horse Power	Reduction Gear Ratio	Cost
Indigenous			
Kirloskar	5	2:1	5,365
	6.5	2:1	5,480
	10	2:1	7,433
Kirloskar/MAN	155/191	2:1	66,000
	205/255	2:1	91,000
Kirloskar/Cummins	93	2:1x3:1	77,858
	165	3:1	112,301
	218	3:1	147,583

Contd..

14/ Source: Central Institute of Fisheries Technology, Cochin.

Table A-14 (Contd)

Name of Engine	Horse Power	Reduction Gear Ratio	Cost
Ruston	16	2:1	21,930
		3:1	22,320
	37	2:1	27,950
		3:1	28,867
	49	2:1	39,450
		3:1	40,382
	73	2:1	58,062
		3:1	58,612
Meadows	54	2:1	31,816
	48-59	2:1	26,750
		3:1	27,000
Kelvin	22	2:1	21,625
	33	1:1	29,069
		2:1	29,699
	44	1:1	37,144
		2:1	41,200
	72	2:1	60,500
	96	2:1	64,500
Imported			
Torpedo (Yugoslavia)	18/27	2:1	7,178
	30/32	2:1	12,250
	27/29	2:1	8,000
	40/45	2:1	14,820
	68	2:1	19,405
Yanmar (Japan)	33	2:1	13,895
			16,131
	60	2:1	24,441
	100	2:1	59,054

Table A-14 (Contd)

Name of Engine	Horse Power	Reduction Gear Ratio	Cost
Bukh (Denmark)	21/34	2:1	14,162
	40/51	2:1	15,770
	56/68	2:1	23,994
	84/102	3:1	60,035
Marna (Norway)	16/24	2.8:1	12,800
		3.8:1	
	24/36	3:1	
		2.5:1	14,825
	32/48	3.2:1	
		3.2:1	35,181
	55/60	3:1	38,600

Caterpillar and the G.M. marine engines are the popular makes widely used in the fishing fleet in the United States. Another manufacturer of marine diesel engine in USA has recently introduced a scheme whereby they offer the engine to any operator for a fishing vessel under construction or proposed to be constructed. The manufacturer finances the cost of the engine to be installed on the vessel at any yard of owner's choice. In case the performance of the engine, after a period of six months, does not prove satisfactory to the owner, the manufacturer gives the facility to replace the engine by any other make of the owner's choice. An arrangement similar to the above may be considered for the installation of indigenous engines of the higher H.P. range being manufactured in the country. The principle should be to discover means of introducing a new item of equipment on competitive basis.

Marine diesel engines were supplied by the State Fisheries Departments on loan-cum-subsidy basis till 1968. The rates of subsidy varied according to the State and sometimes to the region within the State, depending on the progress of mechanisation programme. In view of the high cost of indigenous marine diesel engines when imports were allowed to the Departments of Fisheries, the Departments pooled the imported and indigenous engines as well as their prices and supplied to the fishermen.

From 1968 with the availability of institutional finance from the Agricultural Refinance Corporation through fishermen cooperative societies, the loan was provided by the Corporation against the guarantee of the State Governments and the subsidy portion alone was given by the Departments of Fisheries to the fishermen. In addition, the commercial banks operated a scheme in association with the manufacturers of marine diesel engines for supply of engines on loan subject to certain conditions. This system has been taken advantage of by private fishermen and the operators of fishing vessels supplying raw material to the processing industry. The impact of this system on a selected sector of the industry requires to be watched.

Repair and Service Facilities. The fishing industry has been finding it difficult to get spare parts for replacement, adequate after sales service and repair facilities. Besides bringing about improvement in quality for the special type of operations connected with fishing vessels, manufacturers of marine diesel engines should ensure adequate repair and service facilities to the customers by opening service stations and workshops at selected centres of concentration of the fishing vessels. The manufacturers of Ruston engines have selected Veraval, Porbunder and Bulsar in Gujarat State, Satpati, Bassein, Ratnagiri and Alibagh in Maharashtra; Karwar, Malpe and Mangalore in Mysore State; Cannanore, Cochin and Quilon in Kerala; Cuddalore, Nagapattinam, Colachel, Rameswaram and Madras in Tamil Nadu; and Kakinada in Andhra Pradesh for location of their service stations. M/s Kirloskar Oil Engines Ltd., have service stations in Ratnagiri and Cochin. Manufacturers of Kelvin Marine Diesel Engines have plans to establish service stations at Mandapam and Cuddalore in Tamil Nadu, Arroor, Calicut, Sakthikulangara and Cannanore in Kerala and Malpe in Mysore State.

It is very essential for the manufacturers of engines to execute the plans of locating service centres expeditiously for the benefit of the industry.

Financial Assistance

India. Financial assistance was available till 1967 from the Central and State Governments in the form of loans and grants as well as subsidy for the construction of fishing boats, marine diesel engines and improved types of fishery equipment in the various maritime States. While the loan portion for the mechanisation scheme for fishing craft was financed in full by the Central Government as part of the development plan expediture, the amount of subsidy constituted 50 per cent share, the remaining share being the contribution from the respective States. The pattern of subsidy, however, varied from State to State depending upon the progress of the scheme. In 1967 arrangements were made to provide institutional finance for fishery schemes under which the Agricultural Refinance Corporation (ARC) helped the fishery projects through cooperatives in each State and provided loans with the guarantee of State Governments. This arrangement helped the Departments of Fisheries to concentrate more on developmental schemes by restricting loans to commercially viable fishing projects through institutional finance.

Of late, the commercial banks in the country have also come forward with schemes for financing of fishing boats with the assistance of the manufacturers of marine diesel engines in selected regions. Recently, restriction has been imposed on the import of fishing vessels of less than 60 feet (18.5 m) length. The import is, however, permitted subject to placement of an order for one indigenous fishing vessel of about 60' in length against every two imported ones. This necessitated certain amount of financial assistance for the fishing units to acquire fishing vessels on easy terms. The Industrial Development Bank of India (IDBI) accordingly included fishing vessels under the rediscounting scheme on deferred payment basis over a period of seven years. The deferred payment arrangement, however, needs to be streamlined because the boat owner does not directly get the benefit of deferred payment in the manner in which such facilities are extended for the supply of fishing vessels in other parts of the world.

Norway Some of the important maritime countries of the world have numerous schemes which help their fishing units to arrange for large vessels to exploit the deep sea fishery resources. For instance, construction of vessels in Norway is financed by the Norwegian Fisheries Bank which makes available loans of upto 60 per cent to the fishermen at an interest of only 4½ per cent on the first mortgage, maximum amortization being about 15 years; upto 90 per cent at 2 per cent interest on the second mortage, with maximum amortization of about 15 years; and in special cases upto 100 per cent with no payment of interest or repayment in the first ten years on the third mortage. The low rate of interest for loans on vessels, equipment and loans to the processing industry is met by Government expenditure. To improve and modernise the fleet in Norway, the Government subsidy is available for the scrapping of obsolete vessels with the pre-condition that the assistance must not be utilised to purchase a new vessel without the consent of the State Fishery Bank. The rate of subsidy is as follows:

Upto Rs 600 per G.R.T. for vessels under 20 G.R.T.

Upto Rs 800 per G.R.T. for vessels between 30 and 40 G.R.T.

Upto Rs 900 per G. R.T. for vessels from 41 to 80 G.R.T. and
Upto Rs 1,000 per G.R.T. for vessels above 80 G.R.T.

Canada In Canada, the Federal Government makes available loans to the extent of the entire cost of vessels at 5 per cent interest. The Government also makes available subsidies of 35 per cent on the total cost of wooden vessels. In cases where fishermen avail of all the subsidy, interest on the balance amount of loan is charged at 6½ per cent. If the vessel is below 100 gross tonnes, 65 per cent of the loan is recovered in six years and if the vessel is over 100 gross tonnes, the entire loan is recoverable in 15 years.

United Kingdom In the United Kingdom from 1962 to 1967 operating subsidies were made available for all fishing vessels from a special fund of £ 2.5 million. These subsidies were paid at a flat rate per day according to the size of the vessel from about £8 per day for the distant water trawlers to £ 2 for vessels below 24 metres. In July, 1968, the pattern has been changed and for the next three years upto 31st July, 1971, £ 4 million have been set aside for distribution in relation to the operating efficiency of the vessel instead of the flat rate per day. The amount of subsidy being related to the operational efficiency will act as an incentive to the fishing fleet.

Hong Kong. In Hong Kong HK$ 8½ million have been set aside by the Government for making available loans for the construction of medium and small vessels. The interest on loans is charged at the rate of 6 per cent. The loans are repayble over a period of 10 years.

U.S.A. In USA the Fish & Wild Life Act of 1956 provides for the establishment of revolving fund to be used for giving loans for financing and refinancing of fishing operations and for the maintenance, replacement and repairs of fishing gear and vessels. These loans are repayable in instalments with a maximum maturity of 10 years at an interest of 5 per cent per annum, although fishing vessel owners do not seem to have taken advantage of the provision under this Act, mainly because of the time-consuming procedures for obtaining the loan. This decision resulted in some of the ship-builders as well as the commercial banks adopting the five-year repayment plan on loans for shrimp vessels.

Loans for fishing vessels in the Gulf States are secured by mortgage registered at the custom house where the boat is registered. Vessels for which loans are given are required to be covered by marine insurance for protection and indemnity. The financing of individual shrimp vessels is done primarily through commercial banks on 6 to 8 per cent interest over a period of 5 years. The 1969 Act recommending legislative changes in the 1964 Fishing Fleet Improvement Act promoted optimum use of government funds in achieving economic development of fisheries, leading to judicious control of capital flow into selected fisheries, where the cost of construction of fishing vessels in USA is considerably high and disadvantageous to its fishermen.

In France, Poland, Norway and Germany fishing boat building yards supply fishing vessels on deferred payment basis both to the local and foreign operators. The operator of fishing vessel can take delivery of the vessel on payment of 15-20 per cent of its cost and pay the balance amount over a period of 8-10 years in half yearly or annual instalments at interest ranging from 5-7 per cent.

In addition, some of the developing countries which are also encouraging programmes of construction of fishing vessels, have adopted a policy of subsidising the supply of fishing vessels to the extent of price differential between the cost of home construction and international price over a limited period, about 5-10 years, by which time the local yards should be in a position to construct fishing vessels of quality at international prices. It is, therefore necessary to consider the following assistance for the fishing industry in India towards stepping up of fishing fleet for increasing production leading to additional exports.

i) Facilities should be extended for the purchase of fishing boats from established ship building yards both in the country and outside on deferred payment basis over a period of 7-10 years at a low rate of interest not exceeding 6 per cent per annum. The payment on delivery should not be more than 15-20 per cent of the cost of vessels.

ii) There must be an arrangement for guaranteeing the repayment by mortgage of the vessels to the agency supplying the boat on deferred payment basis.

iii) The difference in the rates of interest on the loan portion should be subsidised by the Government.

iv) The fishing industry should be given subsidy to the extent of the price differential between cost of vessels built in the country and international price of vessel of similar size and specifications.

v) There is no need for subsidising the cost of vessels imported by fishing industry.

vi) The programme of construction of fishing vessels of specialised nature and of proven design should be taken up by the selected boat building yards in India so as to streamline and improve the efficiency of construction of fishing vessels of high quality at international prices within the limited period of 5-8 years.

1.2 Fishing Gear

Fishing gear is an important tool of production of fish. Any improvement in it directly contributes to the increased output of raw material. There are various types of gears in use in India, each one suited to different fisheries. The following are some of the principal types of indigenous gears in operation in different States:

Gujarat:	Drift and gill nets, fixed nets and lines
Maharashtra:	Fixed nets, gill nets and lines
Kerala:	Boat seines, shore seines, gill nets and lines
Mysore:	Shore seines and gill nets
Tamil Nadu:	Shore seines, boat seines and gill nets
Andhra Pradesh:	Shore seines, boat seines and drift nets
Orissa:	Drift and gill nets and lines

Accurate statistics on the fishing gear in different parts of the country are not available. According to the information available from the Central Institute of Fisheries

Technology, Cochin, the present position of the fishing gear is as follows:

	(Numbers)
Shore seines and inshore drag nets	8,580
Fixed nets	35,705
Bag nets and boat seines	91,108
Drift and gill nets	227,711
Other types	76,829

Gear Materials

Improvements in fishing gear materials have kept pace with the advancement in fishing methods during recent years. The increasing use of hemp twine and subsequently synthetic twines from that of the traditional cotton twine is indicative of the achievement in the field of fishing gear though the cotton twine still holds its own position. The evolution of the improved twines and the relative advantages enjoyed by them over the traditional gear material are briefly described hereunder.

Cotton. Cotton twines rank as the most important material used in India for fabrication of fishing nets. Though machine twisted twines are also available the vast majority of Indian fishermen still use single stranded cotton twines made by a simple process of hand twisting. The major defect with hand twisted cords is that there is no definite standard in the amount of twist imparted owing to the personal whim of the individual fisherman who makes the cord. Besides, a single stranded cord is reported to be unstable and contributes to a lower strength of the twisted cord. According to a study carried out by the Central Institute of Fisheries Technology, Indian twines are 16 per cent weaker compared to other countries like Japan, Norway and Britain. Whereas Indian yarn is in no way weak, the relative low strength of the twine is reportedly due to the lack of attention paid in balancing of twist and correct stranding.

According to the requirements of the gear, twines having different degrees of twist are needed. In gill nets for instance soft twisted twines are preferred. Soft twist, by imparting more strength to the twines prevents snapping of the cord by a struggling fish. Since the stretch is less in a soft twine, defiguration of the mesh by the extension of the lags could be avoided, mesh size being important in gill-netting. Moreover, as most fishes gilled are soft bodied, a hard twine easily cuts the body of the gilled fish and leaves only the head on the net. In the trawls which are dragged, the capacity of the twine to stretch is relatively more important. If, however, the twines are rigid and inextensible, breakages while in operation of the gear are more frequent. Therefore, medium twisted twines are used for boat seines, beach seines, dip nets, etc. and hard twisted twines for lines.

Hemp. Next to cotton, hemp is a vegetable fibre widely used for fabrication of gill nets, stake nets, bag nets and also for lines. Hemp twines are used particularly in Gujarat and Maharashtra regions for "Dara" gill nets. Many fishermen of both Maharashtra and Gujarat coasts have started using 'Garfil' monofilament for their 'Dara' nets instead of Italian hemp which had been in use till recently.

Synthetic Fibre. Although the demand for net materials differs from one type of gear to another, the use of fibres of high tensile strength for all types of nets is quite popular. There is no ideal fibre for fishing gear but various types of synthetic fibres each having different properties provide a range of choice best suited to specific fisheries. Many synthetic fibres have now firmly established their superiority as material for fishing nets, such as polyamide, polyester, polyvinyl alcohol, polypropylene, polyethelene, etc. Nylon yarn is produced in three different forms (i) continuous multifilament; (ii) continuous monofilament; and (iii) staple fibre. The common variety of popular nylon continuous monofilament yarn for fishing is 210 denier* each yarn containing 15 to 36 filaments.

The principal characteristics of nylon yarn and twine that have led to its extensive use in the manufacture of fishing nets are: (i) nylon is stronger than other yarns used in fishnet making, (ii) it absorbs sudden and severe shocks and strains, (iii) it is lighter than many other fibres, (iv) its moisture uptake is lower than that of natural fibres, (v) nylon nets are easy to handle and dry more rapidly, (vi) nylon twine is uniform and smooth which makes it less visible in water, (vii) nylon offers good resistance against abrasion in the wet state.

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* Denier is a measure of the thickness of a textile yarn, being the weight in grams of 9,000 metres of yarn, Indian nylon twines are mainly made of 210 denier yarn.

Since the properties of the material influence the catching efficienty of the gear the type of fibre preferred to various types of nets are:

a) Gill Nets. For gill nets, polyamide yarn is more in demand because of its fineness, pliability, elasticity, durability and invisibility.

b) Trawl Nets. Twines for the trawl nets should be fine, strong and of low specific gravity to enable full opening of the net under water. The materials suitable for this gear are polyamide, polyethelene and polypropylene. For the lower body of the trawl net, it is necessary to use materials of higher specific gravity.

c) Seine Nets. In seine nets, material with high density is preferred on account of the speed with which they are operated and for preventing the escape of the encircled fish.

Availability of Nylon. Of the four firms licensed by the Government of India, only one firm namely M/s Garware Nylons have been producing nylon for nets for the fishing industry. The firm has a capacity to produce 1,300 kgs of yarn per day. Its annual capacity to produce fishnet twine is 360,000 kgs. Another unit of this firm M/s Garware

Filament Corporation has developed 'Garfil' twine for 'Dara' fishing from indigenous raw material. The current annual availability of 'Garfil' twine is of the order of 100,000 kgs. The firm has considerably improved the quality of the fishing twine.

In the public and private sectors, the Gujarat Fisheries Central Cooperative Association, the Kerala Fisheries Corporation and the Tungabhadra Board have Net Making Plantswith a capacity to manufacture 400,000 kgs of twine from nylon yarn every year. Keeping in view the current annual demand of nylon twine which is estimated at about 350,000 kgs the existing capacity of nylon yarn is reported to be adequate. With expansion of industry, however, demand for nylon yarn and twine for net making is bound to increase substantially, for which additional capacity for yarn and net making will have to be created.

The price of nylon twine has increased recently from Rs 32.57 per kg to Rs 40.60 per kg. Caprolactum, the basic raw material for the manufacture of nylon twine, is imported and is subject to an import duty of 60 per cent. In addition to this, an excise duty at the rate of Rs 4 per kg is levied on nylon yarn or twine. Being a banned item for export, nylon twine is not eligible for drawback relief. The fishing industry has complained of exorbitant prices of nylon yarn and twine in India compared to international markets. The fishing industry has requested that the supply of twine be ensured to it on comparative international prices. Alternatively, the Government of India may consider the possibility of giving rebate on excise duty on caprolactum till such time this basic raw material is available from local sources.

The only existing firm has been expanding its capacity to produce nylon and twine and the other three licensed firms have not taken up the manufacture of synthetic fishing twine on a regular basis. It is desirable to encourage few more units to take up the production of nylon yarn, synthetic twine and monofilament twine like 'garfil' to introduce an element of competition in the field for the benefit of the fishing industry.

Deck Equipment

The deck equipment for fishing vessels consists of trawl winches, gurdies, line haulers, power blocks, steel wire ropes and floats. Whereas some of these items are and can be manufactured for any size of the boat, certain others can only be partially manufactured within the country. The existing position in respect of these items is as follows:

Trawl Winches. Designs of mechanical trawl winches for boats upto 13.8 m size are available and can be manufactured within the country. Hydraulic winches for larger boats are not manufactured in the country.

Gurdies. The manufacture of this item of equipment does not pose any problem. It can be produced indigenously for all sizes of boats.

Line Haulers. Designs of simple line haulers for small boats are available and can be manufactured indigenously. Import of latest and sophisticated equipment will, however, have to be allowed.

Power Blocks. On account of the difficulty of manufacturing hydraulic motors, which constitute an essential component of this equipment, power blocks cannot be manufactured indigenously at present.

Steel Wire Ropes. The two types of wire ropes generally manufactured are (i) flexible steel wire ropes and (ii) mild steel wire ropes. For fishing, only flexible steel wire ropes are used as they have to be subjected to heavy tension and frequent abrasion. The flexible wire ropes are provided with a hemp core. Indigenous manufacturers are in a position to manufacture all types of wire ropes. Their quality has also improved considerably and the wire ropes are corrosion resistant. Combination leaden wire ropes are not yet manufactured in the country.

Fishing Floats. Different types of fishing floats at present manufactured in India are mainly of glass, aluminium alloy and synthetics. While adequate choice of different floats is available for surface gear, in respect of bottom gear for deeper seas, the choice is very limited. The possibility of large scale manufacture of floats capable of withstanding pressures of great depths still remains to be explored. Until such time these are manufactured in the country, it is recommended that the import of floats capable of withstanding pressures of 40 atmospheres should be permitted.

Recent Developments in Gear

The application of improved types of fishing gear and methods for different fisheries in different fishing grounds has been responsible for increased catches of fish, prawns and lobsters. On the basis of the experiments conducted so far some of the results achieved are indicated below:

(1) The introduction of improved gear has extended the area of operation and development of new designs for shrimp trawling.

(2) Comparative fishing tests with a 15 ft. beam trawl and 45 ft. nylon four seam overhang otter trawl have shown that prawns are more in the catches of the beam trawl.

(3) The catch per hour of trawling has been found to be more in the case of fully mechanised fishing vessel operating the deck equipment with mechanical devices. The catch of prawns and fishes has been more by 43 per cent and 145 per cent respectively.

(4) The use of tickler chain in the beam trawl has shown that the tickler chain generally increases the catches of shrimp by 47 per cent.

(5) The shrimp otter trawls are more effective with heavy ground rope and less buoyancy on the head ropes.

(6) The attachment of tickler chain on the shrimp trawls has increased the prawn landing by about 70 per cent.

(7) Catches of prawns have increased by about 50 per cent when additional wings are provided to the net.

Shrimp Trawling in India. Shrimp trawling experiments were initiated in 1962 at Veraval in Gujarat. These were subsequently extended to other areas. The findings of these experiments in various regions reveal the following results:

(1) Gujarat:

- i) Prawn catch increases progressively in hauls made after 9 A.M and decreases after mid-day.
- ii) Smaller nets are more efficient than bigger ones.
- iii) Tickler chain attached to the foot rope increases the prawn landings.
- iv) Addition of long wings has no apparent effect on the prawn catch.

(2) Bombay. The use of Mexican type of shrimp trawler has shown successful results in shrimp fishing in Bombay area between March and November.

(3) Ratnagiri. Shrimp trawl gear with short wings based on the Russian type, yields good results on the grounds of Ratnagiri. The prawns constitute about 20 per cent of the catch and sometimes during the peak season upto 40 to 60 per cent.

(4) Goa. In Goa, the yield of shrimp has been of the order of 12 to 16 per cent.

(5) Tuticorin. The fishing trawlers in Tuticorin and Kakinada have shown prawns landings of 17 to 20 per cent and upto 28 per cent respectively.

Shrimp Fishing in other Countries. The vessels trawling for shrimp in the Gulf of Mexico use the double out-rigger style, one large and one small net on either side of the vessel. The winch is of the three drum type and two warps from two drums are attached to the larger net on one side and a single warps from the third drum is attached to the small net on the opposite side via a bridle. The nets are hauled alternatively after a specified period so that the ground is covered adequately there being one net always on the ocean bed. The outriggers are designed in a manner to take 1½ times the load of the net and are reinforced with additional stiffenings. The booms extend from a pivot position of either side of the mast perpendicular to the longitudinal line of the vessel and the danger of fouling the fishing gear in the propeller is very remote and headway can be maintained on the vessel even while hauling the net, thus ensuring no loss of catch.

This method of operation helps wider area of fishing ground to be covered and results in larger catches. The Japanese who are now conducting shrimp operations in South America at Paramaribo with a fleet of fourteen American built 22 metre shrimpers have adopted this type of gear.

Considering that increased production of shrimp is directly connected with increased export earnings, it is suggested that this system of out-rigger operation be introduced in the country as soon as possible. As this type of operation has not so far been conducted in India it may be necessary to obtain for a short specified period of two/three years, experienced skippers operating the Gulf of Mexico type shrimp trawlers to train our personnel in the proper handling of the vessel and the gear to ensure an efficient operation.

Tuna Fishing. There is a growing world demand for tuna meat both in the frozen and canned form. In India the catch of yellow and blue fin tuna is negligible at present on account of lack of proper equipment and facilities to exploit this fishery. Vessels of other countries are operating for both blue fin and yellow fin tuna and skip-jack in the Indian Ocean and the Bay of Bengal utilising the long line method of fishing. Except for Japan, whose annual tuna landings from the Indian Ocean are of the order of 150,000 tonnes, precise information about the foreign vessels fishing in the Indian Ocean and the volume of their catches is not available.

Japan's tuna landings are of the order of 354,000 tonnes per annum with the long line method of fishing and an additional 142,000 tonnes of skipjack with the pole and line type of fishing. Though major portion of tuna is caught thousands of miles away from Japan, its organisational pattern is so effective that these fisheries valued at about 84,000 million Yen, are mostly processed on board and also exported to various destinations earning valuable foreign exchange.

In the Laccadives, pole and line fishing is carried out and the product is dried in a special form and exported to Ceylon. Small quantities of skipjack are caught by the hook and line method at Tuticorin, Quilon, Ratnagiri, Veraval, Visakhapatnam and the Andamans. The entire catch of skipjack is consumed in the local market. Steps should be taken to develop tuna and skipjack fisheries to substantially increase the landings and also to process and export the finished product. Experiments have been carried out by the Deep Sea Fishing Organisation on tuna long lining in the past, but though the hooking rate appeared profitable, the efforts were discontinued due to the paucity of proper type of vessels. In many under-developed countries of the world this particular fishery has been exploited and developed in collaboration with the leading tuna fishing nations which possess adequate equipment, expertise and technical skill.

For instance, a joint Malaysian-Japanese Fishing Company started about 10 years ago in Malaysia exported in 1968, frozen and canned tuna worth $ 14.5 million to the markets of USA, Japan, Italy, West Germany and Canada. The vessels of the company are operating in the Indian ocean along with those of South Korea and Taiwan. Singapore, Thailand and Indonesia are some of the other countries which have capitalised on the joint venture schemes for exploiting their tuna resources. It is recommended that the Government of India should encourage the possibility of introducing tuna fishing vessels on charter or collaboration basis over a specified period for the exploitation of this fishery whereby intensified production of tuna can be achieved together with training of Indian personnel on board the vessels and in processing ashore for the export of frozen and canned tuna.

In examining such schemes it would also be desirable to consider the possibility of attracting large companies engaged in fishing and processing of large variety of fish products and having specialised knowledge of the areas and the fisheries. While considering companies which are mostly interested at present in the shrimp trade, it should be equally important to make them take to tuna fishing also as part of their commercial programmes. The fishing companies from Japan, USA, Norway, Korea and Kuwait might meet some of these requirements. The fishing establishments from USSR and Poland would be in a position to contribute to fishing vessels for bottom fish and also take some of the products for their own needs, thus entering into export trade in selected new varieties.

Fishing for Pelagic Fisheries. Until a decade ago, the traditional gear in the North Sea for herring was the drift net and the trawl. With the introduction of the purse seine, followed by the use of the power block and the triplex roller block, the landings of herring increased out of all proportion from the previous years . Norway with an average annual landings of 2 million tonnes of herring, mackerel and capelin is the leading nation in Europe in pelagic fishery landings. About 80 per cent of its catch is converted into fishmeal. These heavy catches are achieved by the large fleet of power block purse seiners where the catch in one set of the gear at times exceeds 500 tonnes.

The use of high density synthetic net is universal in the fleet and nets are as much as 100 fathoms in depth and 330 fathoms in length, when catches are heavy, with brailing system lengthy, the use of fish pumps on large modern purse seiners to easily discharge the catch from the bunt into the hold has become a necessity. As a purse seine with a depth of 100 fathoms has an effective depth of only 65 fathoms when pursing commences a system of a submersible hydraulic single drum has been introduced into the purse seine fisheries in Norway. This has resulted in increasing the effective depth of the net to the maximum efficiency and more even and quicker pursing is effected.

The overseas survey has revealed that the Norwegians are likely to commence using nets having 150 fathoms depth to sustain their herring landings. These 150 fathoms nets will have an effective depth of 90/100 fathoms when the pursing is done by the winch on board the vessel. This may not be possible as the drum capacity of the winch may have only been designed to take the optimum warp and the size of power block may not be commensurate with the very much larger net. To increase the depth of the net by an additional 50 fathoms will cost about Rs 150,000 and renewal of the purse block winch on board will be approximately Rs 400,000. The time lost on the modifications by way of loss of fishing days will also have to be taken into consideration. The submersible purse winch costs about

Rs 430,000 but considering the advantages achieved by it the industry in Norway is introducing the innovation on the large purse seiners.

Japan purse seine fishing yields approximately 1 million tonnes a year. About 70 per cent of its fleet operate the pair system of purse seine and 30 per cent the single vessel. Shortage of labour to manually handle the large purse seine resulted in hydraulically operated vessels with side rubber rollers in them. Recently power blocks of the United States type have been introduced in the vessels but without success perhaps due to the different fishing methods and conditions of the sea between the two countries. The United States tuna industry which prior to the introduction of the power block was also beset with shortage of hands to handle tuna nets also recovered with this speedy and labour saving device. The efficiency of the power block purse seine is best indicated in the case of anchovy fisheries of Peru.

Our present landings of mackerel and sardine which average 270,000 tonnes out of the total pelagic landings of 500,000 tonnes from the beach seine and inshore two boat seine can be substantially increased with the use of power blocks seining in suitable vessels. A beginning has been made in this direction recently although the results are still awaited. The mackerel and sardine season lasts between October and March in the inshore belt on the South West Coast but as the pattern of migration is not yet known it is recommended that investigation in relation to location of the fish should be undertaken by research organisation like the CMFRI, if necessary, with the help of the UNDP, and the result of their findings disseminated to the industry.

Night Fishing. Night fishing has not so far been tried extensively in India for shrimp operations. In Mexico during different seasons 15 to 20 per cent increases in the catch rates have been registered with the use of night fishing. Very few of the trawlers in India so far have been fitted with power to conduct night fishing. Since the 17.5 m new vessels, delivery of which has recently commenced, are fitted with main engine as also stand-by generators with sufficient power it should be possible after successful trials to conduct night operations at various selected centres off the west coast.

Lobster Fishing. Fishing for lobsters has so far been restricted to the coast from Cape Comorin to Colachel in Tamil Nadu. Traps, anchor hocks, scoop nets and bottom gill nets, are being used for fishing lobsters. The traps and lobster gillnets ~~are~~ effective in this area. The scope for introducing this gear in other potential areas for lobsters needs to be tried.

1.3 Electronic Equipment

The electronic equipment for fishing boats consists of fish finders (echo sounder), radio telephone, radar and sonar. In most of the countries the first three items of equipment are fitted on the majority of the ocean going fleet and radio telephone and fish finder on the smaller craft. Norway, Iceland and Denmark where the herring, mackerel and purse-seine fisheries predominate 'sonar' (sound navigation and ranging) has become just as essential as echo sounders were 10 years ago. Due to the successful location of herring and mackerel shoals with the aid of 'sonar' and the resultant heavy landings of fish, crew men are reluctant to work on board any vessel not having this equipment (sonar). Sonar has gained favour and acceptance as a valuable aid in fish detection in North Sea, North Atlantic and Pacific Oceans including the location of albacore, tuna and salmon.

Radio telephones in other countries are essential equipment for medium and large fishing vessels not only from the point of view of safety at sea, receiving instruction on board regarding rectification of defects and for marketing intelligence but also for the cooperative location of fish shoals. In Japan all fishing vessels of more than 100 GRT are equipped with wireless telegraphy sets and radio telephones. Medium vessels of 60 tonnes to 80 tonnes are equipped with radio telephones and the vessels below 50 GRT are equipped with small compact transceivers.

The extent of use of electronic devices as navigational and fishing aids in the shrimp fleet is closely related to the length of vessel and length of trips. Vessels under 12.3 m to 18.5 m length have automatic pilots, 40 per cent depth recorders and 83 per cent radio telephones. All the large vessels over 18.5 m in length are equipped with all the three items referred to above. In addition, 13 per cent are fitted with radio direction finding equipment.*

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*Survey of United States Shrimp Industry, Volume I US Fish and Wildlife Service - Special Scientific Report Fisheries No. 277 Nov., 1958.

Radar is commonly used in large vessels of 22 metre length and above primarily as an aid to navigation in enclosed waters for the prevention of collision at sea with other vessels, obstructions in foggy weather or rains when visibility is poor and to detect the position of the vessel from the shore when within the maximum range of the radar. As an aid to fishing efficiency the use of radar is limited to detecting the position of the gear in long lining and for dense surface shoals of fish at night, particularly tuna. Radar is a costly item of equipment and an imported set having an effective range of 20-25 km costs Rs 15,000. This equipment is not at present manufactured in the country.

A few sets of this equipment have recently been acquired and are in use in India for experimental purposes. Due to the high cost of electronic equipment and the lack of trained personnel for their maintenance and efficient operation there has been a general reluctance to fit this type of equipment even though nobody can deny the vital importance of these instruments to increase the catches and thereby loss of time by resorting to haphazard efforts to locate fish. The electronic equipment are now being imported from countries like Japan and Norway. The requirements of the electronic equipment during the Fourth Plan have been estimated as follows:

Table A-15

Requirements of Electronic Equipment 15/

Year	Fish Finders	Radio Telephone	Radar
1969-70	300	25	15
1970-71	300	25	25
1971-72	450	40	25
1972-73	450	50	25
1973-74	500	70	25
	2,000	210	115

M/s Bharat Electronic Ltd., Bangalore, in cooperation with the Central Institute of Fisheries Technology, Cochin and the Deep Sea Fishing Organisation, Bombay have developed a fish finder suitable for utilisation on fishing vessel upto 13.8 m. The set is light, compact and presents no difficulties for installation as it can be mounted either on the bulkhead or on the table. The arrangements also permit tilting of the recorder set to any desired angle. The set is transistorised and designed for 24 volt

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15/ Working Group on Fisheries, Fourth Five Year Plan.

battery operation and works at 50 KWH. The effective recording depth has been estimated at 200 metres. One of the sets was recently put under preliminary tests at Bombay on board of DSFO vessel and it was found to function satisfactorily with the out-board transducer. The 'white-line' now incorporated in the set is quite clear but the demarcation between the base line and ground fish echoes needs to be made more apparent. The equipment was operated together with an imported set for comparative purposes and the detection of fish on both graphs were to a great extent similar though clarity from the imported set was more pronounced. The engineers of M/s Bharat Electronics were requested to increase the white line effect and also to have a 'quick change' styles incorporated. After effecting the necessary improvements the set would be tried again at varying depths upto 200 metres. Whereas it has proved to be suitable for small crafts, the overboard transducer is likely to present some difficulties in adoption and fitting on-board large vessels due to the height of gun-wale from the sea. The cost of the equipment is estimated at about Rs 4,000 which compared favourably with the imported sets ranging from Rs 3,800 for small units to Rs 15,000 for the larger and more sophisticated ones.

Fish finders which are popular in USA, Mexico, Central and South America in the order of preference are: (a) Furuno, (Japan), (b) Benmar (USA), and (c) Simrad (Norway). Specifications of these makes appear at Annexure I-I. The reasons for their popularity are firstly the reasonable cost of the set and efficient performance and secondly the after-sales service provided by the selling agencies.

In Europe, the preference is for Simrad in the Scandinavian countries and for Kelvin Hughs in the United Kingdom. It is recommended that M/s Bharat Electronics Ltd should undertake manufacture of R/T in collaboration with one of the three above mentioned leading firms to ensure that an efficient and quality product becomes available to the Indian fishing industry. They should also ensure that adequate after-sales service is made available to the customers. Such an arrangement will not only accelerate the programme of production of this equipment in the country but also lead to its export to the neighbouring countries.

1.4 Diesel Fuel

The incidence of high diesel oil cost is a principal factor which contributes to the high cost of boat operation. The survey of the fishing units in the country has revealed that fuel expenses on fishing boats account for 30-40 per cent of the total cost of boat operation. The cost of fuel significantly affects the number of fishing hours, the duration of the fishing trips and the range of fishing area. The current price of high speed diesel oil including excise duty and sales tax is Rs 761.24 per kilo litre. The cost composition of diesel oil is as follows:

	Rs Per kilolitre	Percentage to the total cost
Cost of diesel fuel to fishing industry	761.24	100.00
Cost of fuel	220.00	28.9
Excise duty	481.24	63.2
Sales tax/ surcharge	60.00	7.9

As can be seen from the above, the imposition of excise duty, sales tax and surcharge accounts for 71.1 per cent of the cost of high speed diesel oil. Excise duty alone forms as much as 63.2 per cent of the total cost. Fishing industry in other countries is supplied diesel oil at bounded rates. Compared to the prices of diesel fuel in other countries its price is five to six times higher in India as can be seen from the following:

Country	Price of H.S.D. Oil (Rs per litre)
Venezuela	0.14
USA	0.22
Canada	0.25
Mexico	0.27
Nicaragua	0.27
Norway	0.36
Denmark	0.37
Netherlands	0.42
U.K.	0.56
India	0.77

The price of fuel in India at 77 paise per litre is the highest. In other countries like Venezuela, USA, Canada, and Mexico, the prices of diesel fuel are only 18 per cent, 28 per cent, 32 per cent and 35 per cent of the prices in India. This huge price difference is reflected in the production cost of raw material to the industry and consequently affects the competitive position in the international market.

The Government of India, Ministry of Finance (Department of Revenue) by a notification in June 1968 announced exemption of excise duty on refined diesel oil, intended to be used in any fishing vessel designed for deep sea fishing, which is not less than 13.7 metre in length and fitted with an engine of not less than 150 horse power. While 50 per cent of the excise duty is expempted before undertaking the fishing operation the remaining 50 per cent is allowed on production of proof of export at the rate of 1.08 kilolitre of diesel oil for every tonne of shrimp exported. Whereas this measure is intended to give relief to the export sector of the sea-food indutry, not even one per cent fishing units are eligible to avail of this benefit due to the fact that major portion of the fishing fleet consists of small fishing boats of less than 13.7 m length and less than 150 H.P. With a view to bringing down cost of raw material intended for export to a highly competitive international market, it is recommended that the fishing industry in India should be provided fuel at the duty free rates.

The amount of subsidy on diesel oil for the additional vessels recommended for introduction in the various Project Reports has been worked out on the current prices of fuel on the basis of 180 fishing days in a year for small vessels fitted with 60 H.P. engines at the rate of 12 hours a day; 200 fishing days for medium vessels with 250 H.P. engines at the rate of 16 working hours a day; and 200 working days of 16 hours for large vessels equipped with engines of 400 H.P. The subsidy thus works out to:

No. of Vessels with sizes*	Amount of Subsidy (Rs million)
3,162 small boats	19.70
295 medium vessels	11.32
103 large vessels	6.32
Total	Rs 37.34 million

In addition to the annual rate of subsidy of Rs 37.15 million on diesel oil for the additional vessels, allowance has also to be made for the existing fleet. Since major portion of the existing fishing fleet comprises small boats, and as some of them having outlived their life are likely to go out of operation, the annual amount of subsidy for them works out to Rs 50.21 million on the basis of 7,000 boats fitted with 45 H.P. engine on an average, thereby making a total of Rs 87.55 million for the entire fleet. The supply of duty free diesel oil to the fishing industry has to be viewed in relation to the increased foreign exchange earnings which will more than compensate the loss of revenue by attracting more vessels thereby intensifying fishing activity and augmenting production for export.

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*Small boats - upto 13.8 m size, Medium vessels - 17.5 m and 22 m; large vessels - 27 m and above.

1.5 Payment to Crew

Generally the crew of fishing vessels in India is paid a fixed wage, supplemented by a small share of value of catch in terms of bonus, which is slightly higher for technical personnel depending on their skill and responsibility. The system of payment of fixed wages lacks incentive and the sense of involvement on the part of crew.

In other maritime countries, there exists a wide variety of payment systems, wages sometimes being a variable, sometimes a fixed and sometimes even a combined variable-fixed item. The most common feature is to calculate the crew remuneration as a specified percentage of the gross revenue after deducting fuel costs and other trip expenses. Such a system has the benefit of encouraging the crew to increase catch by their direct involvement. The practice of payment to crew prevailing abroad differs from country to country depending on the type of fisheries.

Canada. In Canada two different systems are being followed: (i) non-payment of fixed salaries by most of the boat owners who allow 63 per cent of the gross earnings to the crew from each trip, responsibility of crew being to meet the total cost of food expenses, insurance, wharfage and maintenance of fishing gear, and (ii) mutual settlement by fleet owners with crew, owners share being 63 per cent of the gross value of the fish while meeting all other expenses except the food of the crew on board.

Mexico. In Mazatlan (Mexico), a cooperative organisation, having about 180 (20 metre length) shrimp trawlers with 250 BHP engines, the skipper and engineer receive a personal allowance of 40 pesos a day while at sea. The fishing trips extend to 18 days and the vessels operate about 16 or 17 trips per year. The average landings of headless shrimp are 7 tonnes per voyage. The crew members do not work on salary basis and the system is to share the gross proceeds of the sale of the shrimp on a 70:30 per cent basis between the cooperative and the crew.

The highest price of the large size shrimp can reach 2,500 pesos per tonne. Any fish taken in the trawler is the property of the crew and the sale proceeds of the same accrue to them. Fuel and other expenses are met by the cooperative society, of which all the crew are members.

A private company in Mexico with a fleet of 12 vessels is using them for hook and line operations for fishing red snapper. The vessels are of 21.5 metre length with 350 BHP, Caterpillar engine. The trips of these vessels last 10 to 14 days with 100 tonnes of ice on each trip and 24 trips a year. The average annual catch of red snapper per vessel is about 240 tonnes. The firm pays the following charges and share of the catch to the crew members. While fishing for a red snapper, the skipper receives per day 60 pesos, engineer 40 pesos and cook 10 pesos while at sea, and 40 pesos per day each for skipper and engineer for shrimp. The average price of red-snapper being about 1,350 pesos per tonne of which the skipper receives 25 per cent and the remaining 75 per cent is divided among the crew members.

For the vessels operating in the Gulf of Mexico, the crew's share on an average is 30 per cent of the total operating cost. Wages of hired crew members vary considerably depending on the nature of the system, the number of fishermen employed on the vessel and the success of operation. Cost of fuel and ice is borne by both owners and crew to a varying degree. Cost of provision is normally split between both owner and the crew. Cost of packing and unloading the products is met by the boat owners when these operations are performed by shrimp plant. Where packing and unloading functions are performed by the vessels owned by the integrated companies, it becomes difficult to apportion the cost.

United Kingdom. In UK fishing skippers are generally paid 5.2 per cent of the gross catch sales and mates are entitled to 3.1 per cent. In case the catch exceeds a definite daily average, the skipper receives a trip bonus of one per cent of the gross, in addition to his 5.2 per cent. A skipper on a deep sea trawler (60 metre length) earns about Rs 100,000 and a really efficient skipper can earn above Rs 200,000 per annum. Skippers, engineers and all other members of the crew are safeguarded against low catch rates or abnormally low market prices and the guaranteed minimum wage for a week is £ 20.6s. The following table indicates the average weekly earnings of crew members on larger trawlers:

Table A-16

Average Weekly Earnings of Fishing Crew in UK 16/

Category	Daily rate of basic pay	Poundage per £ 100	Distant water vessels - average weekly earnings (1967/68)		
			£	sh.	d
Bosun	42/-	25/3	45	3	0
Chief Engineer	49/3	22/3	43	10	1
2nd Engineer	44/-	15/3	33	8	5
Greaser Fireman	40/-	13/3	29	14	7
Deckhand & cook	40/-	13/3	30	8	0
Third hand	40/-	14/4	32	11	5

Norway. The system of payment to crew in Norway is also on percentage basis of catch after deducting 50 per cent of the gross sale proceeds for expenses towards fuel and ice, and the average that a skipper gets is 12 pe cent, mate 7 per cent, engineer 5 per cent and other crew members about 20 to 30 per cent.

16/ Source: IIFT Survey Team.

Poland. In Poland 23 per cent of the gross value realised by the State Fisheries enterprise is paid as wages to the crew. In the case of larger vessels sometimes the percentage of share of the crew is 45 per cent of the net value after meeting fuel expenses.

India. Some of the commercial fishing companies in Kerala have adopted a system of paying a percentage share of the catch to the crew. In Mysore State the South Kanara District Cooperative Fish Marketing Federation had adopted a similar system. The Federation pays 50 per cent share of the value of the catch to the crew after deducting the cost of fuel. The Government of India, realising the merits of the practice of payment of the share of the catch to the crew as an incentive prevailing in other countries, have initiated a scheme of payment to the crew of the fishing vessels engaged in exploratory fishing, in addition to the fixed wages.

It can be generally seen that 30 to 35 per cent of the gross catch value as payment to crew appears a generally accepted principle except in the UK, where the crew members are paid salaries. In spite of the large earnings of the crew on commercial fishing vessels, there is dearth of personnel to go to sea due to the attraction of shore based industry, which has five-day week, social benefits and shore life. This shortage is being felt in Japan, Denmark and the UK where vessels are laid up for non-availability of personnel and the accent today is on automatisation to increase efficiency and ease the hardship of life on board. Fish production on a vessel is dependent largely on the efficiency of the skipper and the willingness of the crew to work round the clock to enable the vessel to show a profit.

In view of the wider acceptance of the system of payment to crew on share basis in the other maritime countries of the world and on account of the fact that it offers an incentive which contributes to:

i) increased catches quantitatively and qualitatively;

ii) reduction in cost of boat operation by taking the minimum number of crew on board; and

iii) economy of fuel and ice in the operation and fishing for the maximum number of hours;

It will be in the large interest of the fishing industry if this system of payment to the crew is adopted for commercial fishing enterprises in India.

1.6 Manpower for Fishing Vessels

The manpower required for operating fishing vessels calls for employment of personnel like fishing skippers, fishing second hands, deep sea drivers and engine drivers in addition to trained fishermen. There are numerous fishermen training centres in the maritime States which are run by the respective Departments of Fisheries. In addition to the training centres managed by the State Governments, some cooperative societies also have arrangements to impart training to fishermen in the operation and maintenance of mechanised vessels. Table A-17 gives information about the number of training centres in each State, their location, duration of the training course and number of personnel that can be trained. While the duration of the course in most of the centres ranges from 6 to 10 months the Centre at Kakinada in Andhra Pradesh offers one year course. The capacity of the Fishermen Training Centres, supplemented by the training facilities available in the cooperative sector is reported to be adequate.

Table A-17

Location of Fishermen's Training Centres[17]

State	No. of Training Centres	Location of Centres	Capacity (Number)	Duration	Total
Gujarat	2	Kolak	30	10 months	60
		Veraval	30	"	
Maharashtra	5	Versova	20	6 months	
		Ratnagiri	20	"	
		Bassein	20	"	100
		Satpati	20	"	
		Alibag	20	"	
Goa	1	Dona Paula	20	"	20
Mysore	1	Mangalore	40	"	40
Kerala	4	Vizhinjom	40	10 months	
		Ernakulam	40	"	
		Beypore	40	"	160
		Cannanore	40	"	160
Tamil Nadu	6	Madras	20	"	
		Cuddalore	20	"	
		Colachal	20	" "	160
		Nagapatnam	20	"	
		Tuticorin	20	"	
		Mandapam	60	"	
Andhra Pradesh	1	Kakinada	25	One Year	25

17/ Source: Central Institute of Fisheries Operatives, Cochin.

The Ministry of Transport have under the Indian Merchant Shipping Act of 1958 prescribed certain regulations relating to the employment of personnel on fishing vessels. Section 76(4) of the Act stipulates that every fishing vessel when going to sea from any port or place in India shall be provided:

(a) if the vessel exceeds twenty-five tonnes gross but does not exceed fifty tonnes gross, with a certificated skipper;

(b) if the vessel exceeds fifty tonnes gross with a certificated skipper and a certificated second hand;

(c) if the vessel is of fifty nominal horse-power or more, with at least one engineer duly certificated, being an engineer of a fishing vessel, who shall be designated as the chief engineer; and

(d) if the vessel is of less than fifty nominal horse-power, with at least one engineer duly certificated, being an engineer of a fishing vessel, who shall be designated as the chief engineer or with at least, one engine driver of a fishing vessel duly certificated.

In accordance with Section 78(1) of this Act, the skipper, second hand, engineer and engine driver of a fishing vessel are required to possess certificates of competency.

The survey revealed that there is acute shorate of trained technical personnel particularly of certificated skippers, fishing second hands, engineers (fishing vessels) and deep sea drivers. In the immediate future, the position is likely to become still more difficult with the commissioning of 40 trawlers ordered by the Government recently and about 45 trawlers likely to be commissioned by the commercial fishing operators.

The shortage of fishing skippers is related to the fact that the requirements of the Indian Merchant Shipping Act, 1958, are such that the second hand to become eligible for appearing for the certificated skipper has to put in one year of sea time in sole charge of a vessel more than 25 GRT. He may also qualify by serving as a second hand under a skipper of a vessel of more than 50 GRT. As there are fewer than 18 fishing vessels having a gross tonnage of more than 50 in the country now, it has not been an easy task for an adequate number of personnel to fulfil the sea time. In view of the shortage of trained staff, there is also some reluctance on the part of the owners of fishing vessel to permit their employees to spend three or four months at the Nautical College. The same is the case with the engineers and deep sea drivers.

Currently the Central Institute of Fisheries Operatives has 10 fishing hands available for appointment. These personnel are not fully qualified as per existing rules to take charge of a vessel of more than 50 gross registered tonnes. As all the new vessels being built or imported will be of more than 50 gross registered tonnes suitable employment for these deck hands is a problem. This may be overcome by placing these personnel on vessels between 25 and 49 GRT or obtaining dispensation for them to function as skippers for a stipulated period in selected areas, after which they could become automatically eligible to obtain their higher certificate.

Efforts have already been initiated in the two institutions of the Central Institute of Fisheries Operatives to train various technical personnel as follows:

Course	Capacity	Duration
Fishing Second Hands	40	15 months
Engine Drivers	40	15 months
Gear Technicians	20	9 months
Boat Building Foreman	20	15 months
Shore Mechanics	10	12 months
Radio Telephone Operators	10	4 months

The estimated requirements of fishing personnel to man vessels proposed to be introduced during the Fourth Plan are as follows:

Skippers	330
Fishing Secondhands	1,350
Sea-going Engine Drivers	330
Engine Drivers Class I	1,300
Shore Mechanics	250
Boat Building Foremen	200
Gear Technicians	250
Radio Telephone operators	330

One of the reasons for shortage of deep sea drivers is that qualified personnel take up employment in harbour crafts on account of better service conditions and are thus not available for fishing vessels. As the rules for the examination of fishing engineers have not yet been finalised by the Government of India in the Ministry of Transport, it has not been possible to obtain the clearanc for employment with the prescribed qualifications. Pendin finalisation of the rules, the Directorate General of Shipping is granting dispensation in individual cases for short periods. It is recommended that this relief should be continued to be given for few more years till such time the training becomes fully effective.

The rules for manning radio telephones on-board the vessels as also ashore, prescribed that the sets be operated by a duly qualified person and he should be in possession of a "restricted licence" issued by the Post Master General. The training courses for these licences are at present held at Bombay, Calcutta and New Delhi when a minimum of seven candidates are available. The duration of the course is about 8 weeks after which the candidate appears for an examination.

It is the standard practice in all other countries that the skipper qualifies himself to operate the radio-telephone equipment. As the training institutions commence their courses only when seven candidates are available, it has been difficult for any qualified second hand or skipper to obtain the required qualification, particularly when due to shortage it is difficult for these personnel to get away for two months to undergo this course.

In view of the increasing requirements of trained key personnel, the facilities at the CIFO will have to be expanded and intensified to make available additional personnel. It is understood that the concerned Departments of the Government of India have been moved to recognise the courses conducted by the CIFO. In the meantime, to enable provision of personnel for the increased number of fishing vessels proposed to be commissioned. It is suggested that experienced second hands may be permitted to handle vessels between 25 and 50 GRT.

The two institutions of the Central Institute of Fisheries Operatives, are not even able to take up candidates for training according to the capacity in view of the fact that the required number of staff has not yet been provided. It is important that the instructors should be in position at the earliest opportunity and necessary facilities provided for practical training without any further delay.

There is no doubt some difficulty in giving the necessary sea time practical training for these candidates in view of the shortage of vessels required for training purposes. Till such time medium and large fishing vessels are introduced in greater numbers, the candidates completing training in the CIFO should be permitted to work on vessels of both government and private institutions and the time spent by them on these vessels should be allowed to count as qualifying sea time. At the same time they may be permitted to be employed by granting dispensation on an annual basis for selected ports and types of fishing vessels. Such an arrangement will not only produce additional number of qualified personnel to man the vessels but also fit in with the phased programme of introduction of larger vessels for commercial fishing purposes. It is, therefore, necessary that -

1) separate rules are framed for the fishing vessels under the Indian Merchant Shipping Act, 1958 immediately;

2) the Directors of Fisheries of the maritime States are authorised to register fishing boats in the different ports within their States;

3) the training provided by the Fishermen Training Centres in the States is recognised for issue of a permit by the appropriate authority of the Directorate General of Shipping for operating small mechanised fishing boats less than 13.8 metres in OAL and 150 horse power and under 25 GRT;

4) the training provided by the Central Institute of Fisheries Operatives for Fishing Skippers, Second Hands, Engine Drivers (Fisheries) be recognised by the Director General of Shipping for purposes of certificate in the special rules for fishing vessels under the Indian Merchant Shipping Act, 1958;

5) candidates possessing Masters, Mates and Second Mates certificates with foreign going and home trade of the merchant navy and equivalent qualifications of the Indian Navy should undergo a full training of the master fishermen's

course at the Central Institute of Fisheries Operatives prior to qualifying themselves as Fishing Skippers, Second Hands and Engineers (Fishing Vessels):

6) the Directorate General of Post and Telegraphs should recognise the training organised by the Central Institute of Fisheries Operatives for issue of necessary certificates for operation of radio telephone on-board fishing vessels by Mates, Fishing Skippers or any other member on the vessel instead of separately employing an operator for RT alone.

Fisheries Management Personnel. Among the maritime countries of the world, Japan is the only country which has a comprehensive system of fisheries education dealing with various aspects of fisheries at all levels. Fisheries education in the country forms an integral part of the national education system. There are as many as 76 senior high schools, two colleges and 14 universities, each one of them engaged in imparting education in fishing operations, fish processing, fisheries management, marine engineering, radio and electronics and general fisheries. All these institutions also provide on-board practical training in their own large fishing vessels. In India, fisheries education and training is imparted by various institutions, the demarcation of their activities being as given in overleaf

Fishermen's Training	Directorates of Fisheries of maritime States and Cooperatives
Staff Training	Departments of Fisheries
Fisheries Administration and Management	Central Institute of Fisheries Operatives, Cochin and Madras
Personnel for inland fishery operatives	Regional Centres at Agra and Hyderabad
Processing of Marine Products	Indo-Norwegian Project, Cochin and the Marine Products Processing Training Centre, Mangalore.

The Departments of Fisheries in the various States have training courses for their staff below the district officers level. The Central Institute of Fisheries Education, Bombay is meant to provide training in fisheries administration and management for district level officers. In the early years most of the candidates to this Institute were deputed by the State Directorates of Fisheries to meet their own requirements. The States will, however, not be able to sponsor their candidates regularly after some time. The subject of fisheries administration and management being of special significance with regard to the various fields like fishing, fish processing, fish marketing, etc. particularly in view of their future expansion, the existing training instituions should in the long run aim to provide comprehensive training opportunities covering all aspects of fisheries. Immediately, however, to cater to the needs for providing competent managers, the Central Institute of Fisheries Education should reorient its activities to provide training to fisheries management personnel drawn from public, cooperative and private sectors of the industry to accelerate the pace of the fisheries development.

1.7 Economics of Boat Operation

Complete details are generally lacking in the fishing units for working out the economics of boat operation. Only six firms owning 71 boats in Kerala have provided the required data during the field survey for assessing the expenditure incurred on various heads like fuel expenses, crew's share, repairs & maintenance of engines and hulls, depreciation, insurance, etc. In view of the limited number of units engaged in large scale fishing, majority of the boats included in this exercise are of small size, their composition being 37 boats of 36' size, 29 boats of 32' length, 4 boats of 30' and one boat of 61' OAL. A summary of the data collected in relation to these boats is shown in Table A-18.

Table A-18 reveals that cost of high speed diesel oil, crew's share, and repairs and maintenance constitute the principal items of expenditure. The cost of diesel oil varies from firm to firm and ranges from 20.7 per cent to 39.4 per cent with an average of 28.7 per cent for all. The share of crew works out to between 15.4 per cent and 36.8 per cent with an average of 25.9 per cent for all the firms. The expenditure on repairs and maintenance ranges from 21.3 per cent to 34.6 per cent, its average share being 27.8 per cent. The cost of ice, wherever it is used, is included in the figures for maintenance and repairs and has not been separately accounted for by any of the boat owners. It is also significant to note that on an average the depreciation of boats works out to 14.6 per cent while for individual firms it ranges between 11.4 and 24.2 per cent. Another important feature is that most of the boat owners, except two interviewed by the survey team, have not insured their boats.

As can be observed from the table, the data collected do not take into account the repayment of capital or the interest thereon. In spite of this, the net result is that two of the fishing firms work just at break-even point

Table A-18

Cost of Boat Operation in Kerala Sector (1968)

(in Rupees)

Sl. No.	No. of Boats	Size of Boats				Value of Shrimp and Fish	Total operating cost	Crew's Share	Fuel	Repairs & Maintenance	Depreciation	Salary	Insurance	Profit or Loss Per Boat per annum
		30'	32'	36'	61'									
1.	14	1	12	1	-	29,238	25,167	6,385 (25.4)	9,927 (39.4)	7,326 (29,1)	1,113 (4.4)	-	420 (1.7)	+ 291
2.	22	1	1	20	-	50,777	44,811	11,380 (25.4)	12,246 (27.3)	12,991 (27.2)	8,194 (18.3)	-	-	+ 271
3.	20	-	10	10	-	18,011	22,503	3,536 (15.7)	7,618 (33.9)	6,152 (27.3)	4,042 (18.0)	1,155 (5.1)	-	- 225
4.	6	-	2	3	1	13,553	43,200	6,648 (20.7)	8,947 (24.6)	10,603 (24.2)	10,603 (11.2)	4,833 (3.4)	1,704	-4,941
5.	4	2	2	-	-	49,700	37,254	13,600 (36.5)	7.705 (20.7)	12,875 (34.6)	2,470 (6.6)	604 (1.6)	-	+3,111
6.	5	-	2	3	-	22,580	28,859	10,629 (36.8)	7,641 (26.5)	6,160 (21.3)	3,280 (11.4)	1,149 (4.0)	-	- 655

Figures in brackets indicate percentage to the total expenditure.

Source: Field Survey

while the other three are running at a loss and only one firm is making a marginal profit. This calls for some relief for the industry to make boat operation a gainful proposition to a reasonable extent so that the processors are attracted to own boats to ensure part of their raw material requirements.

With a view to exploiting the fishery resources in different regions on the east and west coasts of India, the model fishery projects included in this Report envisage the introduction of additional 3,560 vessels by 1978-79. Of these, 398 fishing vessels are proposed to be of medium and large size and the remaining 3,162 of small size. Economics of boat operation in relation to small, medium and large vessels has been worked out. For this purpose the west coast has been divided into four regions viz. Gujarat (Veraval), Maharashtra (Bombay-Ratnagiri), Konkan coast (Mangalore-Goa) and Kerala (Calicut-Cochin-Quilon) in view of the similarity in the fisheries of these regions. Similarly, two regions have been considered for the east coast viz. Madras-Tuticorin and Visakhapatnam.

In working out the operational expenditure, the cost of diesel oil (with and without duty), port dues, share to crew, repayment of capital depreciation, interest on capital, insurance, cost of ice, maintenance and repairs, supply of stores and overheads have been taken into consideration.

i) Manning of Vessels. The number of crew members for each vessel has been worked out on the basis of 6 persons for 13.8 m, 7 for 17.5 m., 8 for 22 m and 10 for 27 m. vessels. There is so far no prescribed standard for manning of fishing vessels in India except the provision contained in the Indian Merchant Shipping Act of 1958, which stipulates the qualifications of skipper, IInd hand, engineer (fishing vessels), and driver (deepsea) to comply with the rules for the safety of life at sea.

ii) Diesel Oil. The cost of high speed diesel oil with duty and without duty has been considered for the purpose of calculations because the cost of high speed diesel oil with duty constitutes a major portion of expenditure, being of the order of 20 to 39.4 per cent of the overall annual expenditure for the firms covered for the operational cost study

iii) Crew's Share. The pattern of payment to crew varies from region to region both in the public and private sectors. The crew of the vessels operated by the Central Government organisations for exploratory and pilot operatio are paid monthly wages consisting of basic time scale plus other allowances. In addition to this, they are entitled to an average of 3 per cent of the share of the gross return from the catch to the skipper, 2 per cent to the engineer and driver and one per cent each to other members. The practice followed by the private boat owners in Kerala is to pay 35 per cent of the revenue from the catch less 50 per cent of the cost of fuel. In Mysore the payment to crew is 50 per cent of the total value of the catch, crew being responsible to meet the cost of fuel. In working out the economics of boat operation for 13.8 m vessels proposed to be introduced, the crew share has been taken at 30 per cent of the value of the catch after deducting the operational expenses. Similarly, the crew's share for 17.5 m, 22mm. and 27 m. vessels has been worked out at 20 per cent in view of the increased catches anticipated from large vessels. With the economic and efficient operation of these vessels the payment to crew is likely to be nearly double than that for the small vessels. This also conforms to the pattern of international level of payment to the crew of fishing vessels.

iv) Depreciation. Depreciation for all the boats has been taken at 10 per cent, normal life of vessels being 10 years. While this principle is true for the large vessels, the rate of depreciation should be 14 per cent for the small vessels taking their life at 7 years, particularly when most of the departments are giving loans for repayment in 7 years and the commercial banks generally do not accept longer life periods for such vessels for purposes of giving loans.

v) Interest on Loan. A uniform rate of 10 per cent on the entire capital cost has been taken into consideration in the present calculations, commensurate with the prevailing bank rate . As against this Prof. Gerhardson's report allows 6 per cent interest only on that portion of the capital received as loan through State Governments. The scope of reduction in rates of interest has to be considered.

vi) Repayment of Capital. Repayment of capital is a quite significant factor and this has been calculated at the rate of 10 per cent taking the life of the vessels at 10 years. This important factor is missing from the cost of boat operation data attempted by Prof. Gerhardson although the rate of depreciation is in agreement with that adopted in these calculations.

vii) Other Expenses. Port dues, insurance, stores and overheads are some of the miscellaneous items which have been duly accounted for.

viii) Gross Returns. In arriving at the gross returns by way of catch for each type of vessel, the prevailing prices of shrimp and fish at different selected centres have been taken into consideration. A standard rate for shrimp at Rs 4,000 per tonne has been uniformally taken for all regions in view of the heavy demand for processing. Fish prices have been calculated at Rs 300 per tonne in Veraval, Goa-Mangalore and Kerala for 13.8 m vessels and at Rs 400 in Maharashtra, Visakhapatnam and Tamil Nadu. The price taken for fish from 17.5 m. vessels is calculated at Rs 300 in Goa-Mangalore and Kerala, Rs 500 in Veraval and Visakhapatnam, Rs 600 in Maharashtra and Rs 400 in Tamil Nadu. Fish prices for 22 m and 27 m vessels have been calculated at Rs 1,000 per tonne in Veraval, Maharasntra, Tuticorin, Visakhapatnam, Kerala and Goa-Mangalore regions. The reason for adopting the higher prices for these vessels is due to the fact that these are meant to be operated for selected fisheries and capture the quality fish.

With this background the economics of boat operation in respect of vessels of 13.8 m, 17.5 m, 22 m. and 27 m. length has been attempted. While complete details of their operation appear subsequently, the summary Table A-19 indicates the net profits in relation to different sizes of vessels operating in different regions using diesel oil at the prevailing prices (including duty) and using duty free oil.

As can be observed, the 13.8 metre vessel operating in Maharashtra, Madras-Tuticorin and Visakhapatnam regions shows a profit of Rs 56,048 per annum working on the basis of the prevailing prices of diesel oil and Rs 82,760 if provided duty free oil. The same size of vessel in Kerala, Veraval and Goa-Mangalore secton works on a profit of Rs 40,6000 and Rs 68,000 while running on oil with duty and duty free oil respectively. The reason for the high rate of profit in Maharashtra, Madras-Tuticorin and Visakhapatnam regions is the higher prices on account of the quality fish landed in these regions.

While a uniform rate of profit is indicated in the case of vessels of 22 m and 27 m length for all regions at Rs 109 000 and Rs 89,000 respectively using oil with duty, if duty free oil is made available to them the profit works out to Rs 177,900 and Rs 175,900 respectively for the

Table A-19

Annual Net Returns in Boat Operation 19/

(Profits in Rs '000)

Region	13.8 m		17.5 m		22 m		27 m	
	Oil with duty	Duty free oil	Oil with duty	Duty free oil	Oil with duty	Duty free oil	Oil with duty	Duty free oil
Maharashtra	56.0	82.7	130.2	169.9	109.0	177.9	89.5	175.9
Madras-Tuticorin	"	"	66.2	105.5	"	"	"	"
Visakhapatnam	"	"	98.2	137.5	"	"	"	"
Kerala	40.6	68.8	34.2	73.5	"	"	"	"
Veraval	"	"	98.2	137.5	"	"	"	"
Goa-Mangalore	"	"	34.2	73.5	"	"	"	"

19/ Source: IIFT Survey Team.

two sizes of vessels. The annual profit for 17.5 m vessels ranges between Rs 34,200 and Rs 130,220 while working on oil with duty depending upon the quality of fish captured in various regions. With duty free oil it indicates a profit varying from Rs 73,500 to Rs 169,500.

The net result of operating these vessels appears to be optimistic in general and more particularly with regard to 13.8 m vessel which shows 19.3 to 23.1 per cent profit while running on oil with duty and 35 per cent to 37.7 per cent on using duty free oil. Again the percentage profit varies from 7.2 to 25.8 in the case of 17.5 m vessel working on diesel with duty and 17 per cent to 36.5 per cent with duty free oil. The margin of profit works out to 16.4 per cent and 6.7 per cent for 22 m and 27 m vessel respectively working on oil with duty and 20.3 per cent and 14.1 with duty free oil. The results detailed in Tables A-20 to A-27 are based on a number of assumptions such as (i) adequate availability of infrastructure facilities like berthing and landing facilities, repair and service facilities, supply of fuel and water, spare parts etc. at the fishing harbours, (ii) optimum efficiency of the crew.

Table A-20

Economics of Operation of 13.8 Metre Trawler (120 BHP) in Maharashtra, Madras-Tuticorin and Visakhapatnam 20/

Capital Cost of Vessel & Gear	Rs 240,000

Crew

Skipper..........	1
Engineer.........	1
Deckhands........	3
Cook/deckhand....	1
Total	6

Operational Cost		With Duty (Rupees)	Without Duty (Rupees)
1. Fuel oil, Lub. oil, water		65,360	25,200
2. Port dues		1,200	1,200
3. Running maintenance		2,000	2,000
4. Ice (½ cost)		9,000	9,000
5. Misc. & Stores		1,800	1,800
Total		79,360	39,200
Repayment of capital	@ 10%	24,000	
Depreciation	@ 10%	24,000	
Average interest on capital	@ 10%	14,600	
		63,600	

Gross Income

Total shrimp & fish 250 tonnes (50 tonnes shrimp & 200 tonnes fish)	
Shrimp @ Rs 4,000 per tonne	Rs 200,000
Fish @ Rs 400 per tonne	Rs 80,000
	Rs 280,000

Net income after deductiing operational cost	Rs 202,640	Rs 240,800
Crew's share @ 30% of net income	Rs 60,792	Rs 72,240
Owner's gross income	Rs 141,848	Rs 168,560

20/ Source: IIFT Survey Team.

Less annual repairs	Rs 6,000	Rs 85,800
Depreciation Repayment Interest on capital	Rs 63,600	
Overheads	Rs 2,400	
Insurance	Rs 4,800	
Ice (½ cost)	Rs 9,000	

Profit

With Duty	Rs 56,048
Without Duty	Rs 82,760

Table A-21

Economics of Operation of 13.8 Metre Trawler (120 BHP) in Kerala, Veraval and Goa-Mangalore 21/

Capital Cost of Vessel & Gear	Rs 240,000

Crew

Skipper	1
Engineer	1
Deckhands	3
Cook/deckhand	1
Total	6

Operational Cost	With Duty (Rupees)	Without Duty (Rupees)
1. Fuel oil, Lub. oil, Water	65,360	25,200
2. Port dues	1,200	1,200
3. Running maintenance	2,000	2,000
4. Ice (½ cost)	9,000	9,000
5. Misc & Stores	1,800	1,800
Total:	79,360	39,200

Repayment of capital @ 10%	Rs	24,000
Depreciation @ 10%	Rs	24,000
Average interest on capital @ 10%	Rs	15,600
	Rs	63,600

Gross Income

Total shrimp & fish 250 tonnes
(50 tonnes shrimp & 200 tonnes fish)

Shrimp @ Rs 4,000 per tonne	Rs	200,000
Fish @ Rs 300 per tonne	Rs	60,000
	Rs	260,000

21/ Source: IIFT Survey Team.

	With Duty (Rupees)	Without Duty (Rupees)
Net income after deducting operational cost	Rs 180,640	220,800
Crew's share @ 30% of net income	54,192	66,240
Owner's gross income	126,448	154,560

Less annual repairs	Rs 6,000
Depreciation	Rs 63,600
Repayment	
Interest on capital	
Overheads	Rs 2,400
Insurance	Rs 4,800
Ice (½ cost)	Rs 9,000
	85,800

Profit

With Duty	Rs 40,648
Without Duty	Rs 68,760

Table A-22

Economics of Operation of 17.5 Metre Trawler (200 BHP) in Maharashtra 22/

Capital Cost of Vessel & Gear	Rs 905,000

Crew

Skipper.............	1
Engineer............	1
Greaser/deckhand....	1
Deckhands...........	3
Cook/deckhand.......	1
Total	7

Operational Cost	With Duty (Rupees)	Without Duty (Rupees)
1. Fuel oil, Lub. oil, Water	79,800	30,700
2. Port dues	1,200	1,200
3. Running maintenance	6,000	6,000
4. Ice (½ cost)	16,500	16,500
5. Misc. & Stores	3,600	3,600
Total	107,100	58,000

Repayment of capital @ 10%	90,500
Depreciation @ 10%	90,500
Average interest on capital @ 10%	59,000
	240,000

Gross Income

Total shrimp & fish 500 tonnes
(100 tonnes shrimp & 400 tonnes fish)

Shrimp @ Rs 4,000 per tonne	Rs 400,000
Fish @ Rs 600 per tonne	Rs 240,000
	640,000

22/ Source: IIFT Survey Team

	With Duty (Rupees)	Without Duty (Rupees)
Net income after deducting operational cost	532,900	582,000
Crew's share @ 20% of net income	106,580	116,400
Owner's gross income	426,320	465,600

Less annual repairs	Rs 18,000
Depreciation) Repayment) Interest on capital)	Rs 240,000
Overheads	Rs 3,600
Insurance	Rs 18,000
Ice (½ cost)	Rs 16,500
	Rs 296,100

Profit

With Duty	Rs 130,220
Without Duty	Rs 169,500

Table A-23

Economics of Operation of 17.5 Metre-Trawler (200 BHP) in Goa-Mangalore and Kerala 23/

Capital Cost of Vessel & Gear	Rs 905,000

Crew

Skipper.............	1
Engineer............	1
Greaser/deckhand....	1
Deckhands...........	3
Cook/deckhand.......	1
Total	7

Operational Cost	With Duty (Rupees)	Without Duty (Rupees)
1. Fuel oil, Lub. oil, Water	79,800	30,700
2. Port dues	1,200	1,200
3. Running maintenance	6,000	6,000
4. Ice (½ cost)	16,500	16,500
5. Misc & Stores	3,600	3,600
Total	107,100	58,000
Repayment of capital @ 10%	90,500	
Depreciation @ 10%	90,500	
Average interest on capital @ 10%	59,000	
	240,000	

Gross Income

Total shrimp & fish 500 tonnes (100 tonnes shrimp & 400 tonnes fish)

Shrimp @ Rs 4,000 per tonne	400,000
Fish @ Rs 300 per tonne	120,000
	520,000

23/ Source: IIFT Survey Team.

	With Duty (Rupees)	Without Duty (Rupees)
Net income after deducting operation cost	412,900	462,000
Crew's share @ 20% of net income	82,580	92,400
Owner's gross income	330,320	369,600

Less annual repairs	Rs 18,000
Depreciation	Rs 240,000
Repayment	
Interest on capital	
Overheads	Rs 3,600
Insurance	Rs 18,000
Ice (½ cost)	Rs 16,500
	Rs 296,100

Profit

With Duty	Rs 34,220
Without Duty	Rs 73,500

Table A-24

Economics of Operation of 17.5 Metre-Trawler (200 BHP) in Veraval and Visakhapatnam 24/

Capital Cost of Vessel & Gear	Rs 905,000

Crew

Skipper.............	1
Engineer............	1
Greaser/deckhand....	1
Deckhands...........	3
Cook/deckhand.......	1
Total	7

Operational Cost	With Duty (Rupees)	Without Duty (Rupees)
1. Fuel oil, Lub. oil, Water	79,800	30,700
2. Port dues	1,200	1,200
3. Running maintenance	6,000	6,000
4. Ice (½ cost)	16,500	16,500
5. Misc & Stores	3,600	3,600
Total	107,100	58,000
Repayment of capital @ 10%	90,500	
Depreciation @ 10%	90,500	
Average interest on capital @ 10%	59,000	
	240,000	

Gross Income

Total shrimp & fish 500 tonnes (100 tonnes shrimp & 400 tonnes fish)	
Shrimp @ Rs 4,000 per tonne	400,000
Fish @ Rs 500 per tonne	200,000
	600,000

24/ Source: IIFT Survey Team.

	With Duty (Rupees)	Without Duty (Rupees)
Net income after deducting operational cost	492,900	542,000
Crew's share	98,580	108,400
Owner's gross income	394,320	433,600

Less annual repairs	Rs 18,000
Depreciation	Rs 240,000
Repayment	
Interest on capital	
Overheads	Rs 3,600
Insurance	Rs 18,000
Ice (½ cost)	Rs 16,500
	296,100

Profit

With Duty........Rs 98,220
Without Duty...Rs 137,500

Table A-25

Economics of Operation of 17.5 Metre-Trawler (200 BHP) in Tuticorin-Madras 25/

Capital Cost of Vessel & Gear	Rs 905,000

Crew

Skipper............	1
Engineer...........	1
Greaser/deckhand...	1
Deckhands..........	3
Cook/deckhand .	1
	7

Operational Cost	With Duty (Rupees)	Without Duty (Rupees)
1. Fuel oil, Lub. oil, Water	79,800	30,700
2. Port dues	1,200	1,200
3. Running maintenance	6,000	6,000
4. Ice (½ cost)	16,500	16,500
5. Misc & Stores	3,600	3,600
Total	107,100	58,000
Repayment of capital @ 10%	90,500	
Depreciation @ 10%	90,500	
Average interest on capital @ 10%	59,000	
	240,000	

Gross Income

Total shrimp & fish 500 tonnes (100 tonnes shrimp & 400 tonnes fish)	
Shrimp @ Rs 4,000 per tonne	400,000
Fish @ Rs 400 per tonne	160,000
	560,000

25/ Source: IIFT Survey Team.

	With Duty (Rupees)	Without Duty (Rupees)
Net income after deducting operational cost	452,900	502,000
Crew's share @ 20% of net income	90,580	100,400
Owner's gross income	362,320	401,600

Less annual repairs	Rs 18,000
Depreciation Repayment Interest on capital	Rs 240,000
Overheads	Rs 3,600
Insurance	Rs 18,000
Ice (½ cost)	Rs 16,500
	296,100

Profit

With Duty	Rs 66,220
Without Duty	Rs 105,500

Table A-26

Economics of Operation of 22.0 Metre-Trawler (350 BHP) in all Maritime States 26/

Capital Cost of Vessel & Gear Rs 1,870,000

Crew

Skipper	1
Second Hand	1
Engineer	1
Greaser/deckhand	1
Deckhands	3
Cook/deckhands	1
Total	8

Operational Cost	With Duty (Rupees)	Without Duty (Rupees)
1. Fuel oil, Lub. oil Water	139,800	53,700
2. Port dues	1,200	1,200
3. Running maintenance	12,000	12,000
4. Ice (½ cost)	25,000	25,000
5. Mics & Stores	4,800	4,800
Total	182,800	96,700

Repayment of capital @ 10%	187,000
Depreciation @ 10%	187,000
Average interest on capital @ 10%	134,000
	508,160

Gross Income

Total shrimp & fish 720 tonnes
(120 tonnes shrimp & 600 tonnes fish)

Shrimp @ Rs 4,000 per tonne	480,000
Fish @ Rs 1,000 per tonne	600,000
	1,080,000

26/ Source: IIFT Survey Team.

	With Duty (Rupees)	Without Duty (Rupees)
Net income after deducting operational cost	897,200	983,300
Crew's share @ 20% of net income	179,440	196,660
Owner's gross income	717,760	786,640

Less annual repairs	Rs 36,000
Depreciation Repayment Interest on capital	Rs 508,160
Overheads	Rs 3,600
Insurance	Rs 36,000
Ice (½ cost)	Rs 25,000
	Rs 608,760

Profit

With Duty	Rs 109,000
Without Duty	Rs 177,880

Table A-27

Economics of Operation of 27.2 Metre-Trawler (450 BHP) in all maritime States 27/

Capital Cost of Vessel & Gear Rs 2,800,000

Crew

Skipper............	1
Second Hand	1
Engineer..........	1
Greaser/deckhand...	1
Deckhands.........	5
Cook/deckhand......	1
	10

Operational Cost		With Duty (Rupees)	Without Duty (Rupees)
1. Fuel oil, Lub. oil, Water		176,000	68,000
2. Port dues		1,800	1,800
3. Running maintenance		18,000	18,000
4. Ice (½ cost)		41,000	41,000
	Total	242,300	134,300
Repayment of Capital @ 10%		276,000	
Depreciation @ 10%		276,000	
Average interest on capital @ 10%		180,000	
		732,000	

Gross Income

Total shrimp & fish 1,040 tonnes
(140 tonnes shrimp & 900 tonnes fish)

Shrimp @ Rs 4,000 per tonne	560,000
Fish @ Rs 1,000 per tonne	900,000
	1,460,000

27/ Source: IIFT Survey Team.

	With Duty (Rupees)	Without Duty (Rupees)
Net income after deducting operational cost	1,217,700	1,325,700
Crew's share @ 20% of net income	243,540	265,140
	974,160	1,060,560

Less annual repairs	Rs 54,000
Depreciation Repayment Interest on capital	Rs 732,000
Overheads	Rs 3,600
Insurance	Rs 54,000
Ice (½ cost)	Rs 41,000
	Rs 884,600

Profit

With Duty	Rs 89,560
Without Duty	Rs 175,960

2. PROBLEMS OF PROCESSING

2.1 Structure of Fish Processing Industry

The freezing and canning industry has registered a phenomenal growth during the last sixteen years. The first freezing and canning units were set up in India in 1953 and 1959 respectively to take advantage of the rising export demand for frozen and canned fishery products, particularly shrimp. Since then exports have picked up rapidly. They constituted about 44 per cent of India's total exports of fishery products in 1960, 80 per cent in 1965, and over 90 per cent in 1968 and 1969.

Cochin was the first centre developed for shrimp freezing and canning industry. The development gradually spread over to other parts of Kerala, followed later by Bombay and Mangalore on the west coast. Recently a few units have been established on the east coast as well, in the States of West Bengal, Orissa and Tamil Nadu, and in Goa on the west coast.

Freezing Units. At the end of 1968 the country had 48 freezing factories. Details of the number of units located in various centres with their processing capacities are given in Table B-1.

Table B-1

Locational Distribution of Freezing Facility[1/]

Location	No. of units	Estimated Freezing Capacity		Actual Production		Production as percentage of Capacity
		Tonnes	Percentage of total	Tonnes	Percentage of total	
Cochin and Alleppey	25	40,800	68.8	9,296	6.18	22.8
Quilon Trivandrum	6) 1)	7,800	13.1	2,846	19.0	36.5
Calicut	2	800	1.4	511	3.4	63.9
Mangalore	4	4,300	7.3	1,332	8.9	31.0
Bombay Goa Ratnagiri	4	4,400	7.4	844	5.7	19.2
Madras	3	600	1.0	131	0.9	21.8
Calcutta and Cuttack	3	600	1.0	39	0.3	6.5
Total	48	59,300	100.0	14,999	100.0	25.3

[1/] : Source: Marine Products Export Promotion Council, Ernakulam.

As can be seen from Table B-1, the total freezing capacity in the country is roughly about 59,000 tonnes. Of this, Kerala alone accounts for 49,400 tonnes, Bombay and Goa 4,400 tonnes, and Mangalore 4,300 tonnes.

Canning Units. In the canning field there are 42 units with an estimated capacity of 11,442 tonnes, Kerala accounting for as many as 31 units with a capacity of 9,700 tonnes. Three units each are located in Mysore, Maharashtra and Goa. The details of actual production in each sector are shown in Table B-2.

It will be seen from Tables B-1 and B-2 that Kerala accounts for as much as 84 per cent of the freezing and 85 per cent of the canning capacity in the country. This area fulfils all the essential requirements for the successful development of a seafood industry. These include rich prawn fishing grounds accounting for 43 per cent of total catch of prawns and other crustaceans, easy road communications, safe landing and berthing facilities for small mechanised fishing boats in river mouths and frequent call of vessels with reefer space for shipment.

Maharashtra, West Bengal, Tamil Nadu and Andhra Pradesh also have fairly good catches but the growth of processing facilities there has not been commensurate

Table B-2

Locational Distribution of Canning Facility[2/]

Location	No. of units	Estimated Canning+ Capacity Tonnes	Estimated Canning+ Capacity Percentage of total	Actual Production Tonnes	Actual Production Percentage of total	Production as percentage of Capacity
Cochin Alleppey Calicut	31	9,700	84.7	2,169	97.0	22.4
Goa Ratnagiri	6	706	6.2	27	1.2	3.8
Mangalore Malpe	3	768	6.7	41	1.8	5.3
Tuticorin	1	134	1.2	-		-
Orissa	1	134	1.2	-		-
Total	42	11,442	100.0	2,237	100.0	19.5

2/ : Source : Marine Products Export Promotion Council, Ernakulam.

+ : Capacity is estimated on the basis of two shifts for 200 days.

with the increase in landings. Lack of local initiative for investment in this field and availability of ready markets for fresh prawns in the neighbouring cities like Calcutta, Bombay and Madras are the main reasons for this slow development. It is only recently that a few small processing plants have been established in these areas by experienced processors from Kerala.

Growth of Export Firms. While the number of processing units is only 90, the number of export firms is much larger. (Complete list of exporters as on 31st October, 1969 appear in Volume VI of this Report). A statement showing the region-wise distribution of the export firms during the years 1968-69 is given below:

Table B-3

Regionwise Distribution of Export Firms 3/

Region	Total No. of export firms in 1968	1969		
		No. of firms discontinued	New Firms	Total
Cochin-Alleppey	123	42	22	103
Quilon	14	5	2	11
Bombay	28	2	-	26
Calicut	11	8	2	5
Mangalore	10	-	4	14
Tamil Nadu	3	-	-	3
Calcutta	3	-	-	3
Goa	4	1	-	3
Total	196	58	31	168

3/ Source: Marine Export Promotion Council, Ernakulam.

It will be seen that the number of exporters as on 31st October, 1969 was 168. This number is 28 less than the total number of exporters at the end of 1968, when the number of exporters had reached a record figure of 196. A characteristic feature of the growth of export firms in the fishery trade is that every year a large number of firms go out of business on account of financial losses, but despite this, there is always a large number of new entrants in this industry. In 1967-68, about 7 firms - all from the Cochin area went out of business but 19 new entrants joined the industry. In 1969, 58 firms discontinued operations and 31 new firms came into existence. Out of 58 firms that went out of business during 1969 as many as 55 were from Kerala. New entrants seem to be attracted to this business on account of the relatively low investment required, the liberal credit facilities available to exporters from the normal commercial channels and the absence of any licensing restrictions.

The investment required for a one tonne freezing unit and a canning unit capable of producing 5,000 cans per day is estimated to be about Rs 170,000 and Rs 60,000 respectively*. Besides, with the present availability of the various processing facilities, like freezing, canning, ice and cold storage, on hire or lease basis, a new entrant needs only a small working capital for starting the business.

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*This also includes 1 tonne per day ice plant capacity, 5 tonnes ice storage and cold-storage facilities, but excludes costs of land and building

Capacity Utilisation. Of the existing freezing and canning capacities, only 25 and 19 per cent respectively are currently being utilised. This is largely due to the non-availability of adequate and regular supplies of raw materials for these units, with the result that to reduce the burden of their fixed and overhead costs, many freezing units are leasing or hiring out their idle capacities. It has however been observed that the parties who hire freezing facilities have not been found to stick to that arrangement for long. For example, out of over 90 such parties who started freezing operations in Cochin area during the last three years, only 15 put up their own plants during 1967-68, while about 58 had to go out of business by 1968 due to losses incurred by them.

Another important feature of the industry is the continuous expansion of the freezing and canning capacities despite the under-utilisation of the existing capacity, as can be seen from Table B-4

Table B-4

Trends in Capacity Utilisation in Selected Freezing and Canning Units 4/

Tonnes per day

Unit	1965		1966		1967		Percentage in change 1967 over 1965	
	Installed Capacity	Utilised Capacity	Installed Capacity	Utilised Capacity	Installed Capacity	Utilised Capacity	Installed Capacity	Utilised Capacity
Freezing	49 (10 firms)	3.18	50 (12 firms)	38.4	80 (15 firms)	44.2	63	40
Canning	3 (4 firms)	2.7	6.7 (10 firms)	3.7	7.6 (11 firms)	4.0	140	50

4/ : Source: Central Institute of Fisheries Technology, Ernakulam.

The seasonal nature of the prawn fishery is responsible for this phenomenon. Although more than 80 per cent of the fishing is spread over a period of 6 to 8 months, the peak season lasts only for three to four weeks at a stretch when the catch is large enough to use the entire processing capacity. With such a fluctuating fishery the processing industry has to choose between two alternatives: (a) a limited capacity to attain higher percentage of utilisation during the major portion of the year and thereby reducing the burden of fixed investments; or (b) a peak load capacity to take advantage of the bumper catch periods. The optimum capacity indeed, would be the one which minimises the cost of idle capacity and maximises the gain from the seasonal abundant catches. The processing industry in India has made its choice in favour of having large capacities. In USA, Mexico and some of the Central American countries the capacity utilisation is in an average range of 50 to 60 per cent over the year. If the freezing and canning plants operate to about 50 per cent capacity, they are considered as economical.

Export Performance. The export performance of the processing firms in India ranges from a few thousand rupees to about Rs 30 million. Despite the large number of processing plants, exports are concentrated in the hands of a few exporters. As will be seen from Table B-5., the first 13 freezing and canning units accounted for 57 per cent of the total exports in 1968 with a turnover of about Rs 5 million each. Forty-one firms with exports of Rs 1 million and above each, contributed more than 90 per cent of the total exports. In dried fish industry also, 19 firms out of 76 accounted for more than 70 per cent of the total exports. Such high individual export performance has been achieved not only by units owning large processing plants, but also by some of those who have hired or taken processing facilities on lease.

The seafood industry is almost fully export-oriented and dependent on overseas markets. Hardly any frozen goods are sold internally because of inadequacy of storage, transport and distribution facilities. The industry thus has a weak domestic base as there is no developed internal market to fall back upon in case of any unfavourable trade trends, like a possible significant decline in the world demand or heavy fall in prices. Suggestions for building up a domestic market for frozen products appear elsewhere in the report.

Table B-5

Distribution of Processing Firms by Export Performance During 1968 5/

Range	No. of units	Export performance in Rupees	Percentage of frozen canned or dried goods	Percentage of total marine products exports
Frozen & Canned				
Rs 5,000,000 and above	13	106,306,516	57.22	48.13
Rs 1,000,000 to 5,000,000	28	62,190,515	33.47	28.16
Rs 500,000 to 1,000,000	14	10,967,936	5.90	4.96
Rs 100,000 to 500,000	22	5,633,646	3.03	2.55
Below 100,000	13	696,030	0.38	0.32
Total	90	185,794,643	100.00	84.12
Dried Fish				
Rs 1,000,000 and above	5	7,713,757	32.29	3.49
Rs 500,000 to 1,000,000	14	9,386,080	39.29	4.25
Rs 100,000 to 500,000	20	5,490,463	22.99	2.48
Below 100,000	37	1,294,788	5.43	0.58
Total	76	23,884,788	100.00	10.00
Other Products	-	11,166,806	-	5.08
Total Marine Products Exports		220,846,233	-	100.00

5/ Source: Field Survey

Raw Material. The crux of the problems facing the processing industry and the exports of marine products lies in the inadequate supplies of raw materials. There are three factors which characterise the shortage of raw materials and its impact on the growth of exports: (a) There exists a large and continuously growing market for the Indian seafoods, especially for frozen and canned shrimp products. The US market, for instance, appears to be large enough to absorb for some time the entire quantity of frozen shrimp produced in India. This is revealed by the increasing quantity of exports from India to USA during the last three years and the fact that all firms, large or small, are able to export their entire production as can be seen from Table B-6 relating to the production and exports of selected firms.

Japan, UK, France, Belgium, Germany and other countries in Europe are the other areas where demand for Indian products is increasing. In Japan, there is a strong consumer preference for bigger sizes of frozen prawns, and consequently Japan has been importing more and more of bigger sizes of prawns from India, while UK and Europe are showing greater interest in Indian canned prawns.

Table B-6

Production and Exports of Selected Firms 6/ (1967-68)

(Quantity in Kgs)

Firm	Product	Production	Exports*	Local Sales and Damages
	Frozen			
1	Prawns and Lobsters	642,237	727,849	-
	Froglegs	108,690	102,849	-
	Total	750,927	830,702	-
2.	Prawns and Lobsters	795,575	857,829	190
	Froglegs	9,783	9,784	
	Total	805,358	867,613	190
3.	Prawns	668,812	668,812	3,600
	Lobsters	7,125	7,125	-
	Total	671,863	677,792	3,600
4.	Prawns	365,354	358,896	-
5.	Prawns	495,783	317,735	51,700
	Lobsters	17,630	8,225	796
	Froglegs	67,673	59,012	2,120
	Total	576,919	384,972	54,616
6.	Prawns	33,458	54,500	-
	Lobsters	625	633	-
	Total	34,083	55,133	-
	Canned			
7.	Prawns	1,102,168	1,203,060	-
8.	Prawns	242,863	212,003	-
9.	Prawns	507,361	450,000	-
10.	Prawns	340,753	317,836	-

6/ Source: Field Survey

*Exports in this table are usually larger than quantities produced. Since more than 90 per cent of the sales to USA are on consignment basis, quantities produced and sent on consignment in 1966-67, but sold in 1967-68, are added in the export figures of the 1967-68 year. Similarly, when exports are less than production, this is usually due to shipment the arrival of a reefer ship.

(b) The industry has developed a large capacity for processing frozen and canned seafood products as indicated in the preceding section, encouraged and attracted by the prospects of sales offered by a strong market demand. It has a large unutilised capacity for want of raw materials. Given adequate supplies of raw materials, it can step up production considerably. It represents a large demand for raw materials.

(c) Short supply has resulted in sharp rise in the prices of raw materials; imposed a limitation on the quantities produced for exports; and caused considerable under utilisation of the existing processing capacity. These factors have significantly affected the cost of production and the relative profitability and competitiveness of the Indian processed seafoods in the world market.

It is estimated* that to produce one tonne of frozen product, double the quantity of raw material is required, while the ratio is 1:4 for canning. This is due to the nature of processing and the loss of weight involved in processing the headless or peeled & deveined products. For example, the "Poovalan" variety of whole prawn yields only one-fourth of its original weight when peeled, deveined and cooked for canning or freezing into cooked frozen products. "Seanaran" yields 50 per cent in meat form as seen from the table blow:

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* The ratios are about the same in other countries also.

Table B-7

Percentage Yield from Raw Material of Different Varieties [7]

	P.indicus (sea Naran)	M.affinis (Kazhandan)	M.dobsoni	P.stylifera (Karikadi)
Headless				
On beheading	67.0	65.0	-	-
After freezing (thawed yield)	62.0	60.0	-	-
Peeled and Deveined				
On peeling	50.0	46.0	44.0	40.0
After freezing (thawed yield)	44.0	40.0	37.0	32.0
After cooking (thawed yield)	36.0	30.0	25.0	20.0

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[7] Source: Central Institute of Fisheries Technology, Ernakulam.

Thus to fully utilise the freezing and canning capacities, approximately 162,000 tonnes (118,000 tonnes for freezing and 44,000 tonnes for canning) of raw materials are required. Against this total potential demand of 162,000 tonnes, the 1967 output of export variety of raw materials (prawns, lobsters, and froglegs) was only 58000 tonnes, with the result that a large proportion of the existing capacity remained unutilised; thereby limiting both production and exports.

Unit Value Realisation. From the point of view of processing for exports, it is not only the quality of catch that is relevant, but also the size of shrimp caught. Among the four major varieties, the largest size, "sea Naran" fetches the maximum export value in the overseas markets. For example, counts of the same variety, 16/20 were quoted at a price of $ 1.50 per lb. in June 1968 as against $ 0.51 for counts '130 up' as seen in the Table B-8 on trends in prices in the USA.

Table B-8

Trends in Wholesale Prices of Indian Shrimp in the US Market 8/

(Value in Cents per Kg.)

Variety	1966			1967			1968	
	Jan.	July	Dec.	Jan.	July	Dec.	Jan.	June
Peeled and Deveined Counts								
13/15	-	-	-	-	145	-	145	-
16/20	115	124	130	132	138	135	141	150
21/25	107	119	125	127	132	135	136	140
36/40	93	107	110	111	109	113	113	114
41/50	89	104	105	105	100	101	102	93
91/100	72	86	-	-	68	65	64	62
111/130	69	-	-	-	65	57	57	44
130/up	68	86	59	59	44	41	44	44
Headless								
13/15	106	125	119	120	135	142	141	160
16/20	101	119	115	118	130	131	131	140
21/25	94	114	110	111	111	115	115	128
36/40	72	95	85	85	76	74	74	84
61/70	-	-	-	-	49	45	45	51

Because of this, in the raw materials purchase market, "Sea Naran" is sold at a higher price of about Rs 8 to 9 per kg. of whole prawn as against Rs 2.20 for "Poovalan" as seen from Table B-9

8/ Source: Green Sheets, published by the Bureau of Commercial Fisheries, Department of Interior, Washington, USA.

Table B-9

Trends in Raw Material Prices in Kerala [9/]

Rupees per Kg.

Item	1967				1968			Percentage change 1968 over 1967	
	Whole	Headless	Peeled	Whole	Headless	P & D	Whole	Headless	P & D
Sea naran	7.7	12.9	-	8.8	14.6	-	14.3	13.2	-
River naran	3.31	4.50	5.6	4.4	6.15	6.71	33.3	10.0	19.6
Kazhandan	4.0	4.8	8.0	4.4	8.5	9.5	10.0	46.6	18.8
Poovalan	1.62	-	4.2	2.20	4.50	5.6	37.5	-	33.3
Lobster	14.0	-	-	17.5	-	-	25.0	-	-
Froglegs	4.25	-	-	5.0	-	-	17.6	-	-

[9/] : Source : Field Survey.

Sizewise Export of Prawns. The size-wise export data on frozen prawns for the last three years (1965-68) indicate that there has not been any significant variation in the share of large sizes (u/110) of prawns. In actual quantity such size grades are even showing an increase as the total quantity of exports has been on the increase during this period.

Table B-10

Percentage Distribution of Sizes in Frozen Prawn Exports 10/

	1965-66	1966-67	1967-68
Large Sizes			
Headless			
U/15	0.13	0.12	0.34
6/10	0.49	0.72	1.22
11/15	2.46	2.97	3.72
16/20	4.93	5.62	5.85
21/25	4.95	3.42	4.67
26/30	2.61	2.33	2.36
31/35	1.71	1.25	1.36
36/40	1.40	1.94	2.14
41/50	1.95	2.54	3.60
51/60	1.44	2.07	2.87
61/70	0.84	1.36	1.75
71/90	0.74	1.18	1.10
91/110	1.04	0.91	0.91
	24.69	26.43	31.89

Contd..

10/ Source: Central Institute of Fisheries Technology, Ernakulam.

Table B-10 (Contd)

	1965-66	1966-67	1967-68
Peeled & Deveined			
U/10	0.08	0.06	0.06
11/15	0.07	0.12	0.11
16/20	1.04	0.91	0.41
21/25	2.22	1.50	0.68
26/30	2.62	1.23	0.76
31/35	1.82	1.22	0.59
36/40	1.66	0.98	0.76
41/50	1.03	1.38	1.39
61/70	2.48	1.50	1.26
71/90	3.28	2.46	3.24
91/110	3.35	2.64	2.37
	20.65	14.00	11.63
Total for Large sizes	45.34	40.43	43.52
Small Sizes			
Headless			
111/130	0.10	-	0.02
Peeled & Deveined			
111/130	5.07	12.53	5.14
130/Up	29.27	29.53	31.65
Small (Titis)	-	3.33	-
CP	15.23	8.70	5.65
CPD	0.85	2.30	10.62
Total for Large and Small Sizes	50.42	56.39	53.06
Grand Total	95.86	96.82	96.60

As can be seen from Table B-10 headless form constituted only about 32 per cent of the total production while the major portion upto 53 per cent of the total was composed of smaller sizes of shrimp in the form of P & D* 111/130, P & D 130/UP and CPD.

An obvious cutcome of the inadequacy of raw materials against the freezing and canning capacities has been a sharp rise in the raw material prices. As is evident from Table 9, prices of prawns, lobsters and froglegs have increased substantially during the past two years. "Sea Naran", which earns the highest price in the foreign markets because of its larger size, cost 14 per cent more in 1968 as compared to the 1967 prices. Prices of "Poovalan", which is caught in proportionately larger quantities and is utilised both for freezing and canning, had increased by 37 per cent. During the same period the prices of lobsters and froglegs have risen by 25 per cent and 17.6 per cent respectively. The rising procurement prices have led to an increased cost of production and a narrower margin of profit. The significance of raw material costs in the overall production costs is brought out in the Table B-11.

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* Peeled and Deveined.

Table B-11

Share of Raw Material Costs in the Ex-factory Costs of Selected Firms 11/

Firm Code	Purchases as a % of total Raw Material Requirements	Own Boat Catch as a % of the Total Raw Materials Requirements	Raw Material Cost as a % of Ex-factory Costs
Freezing			
1	98.2	1.8	75.6
2	88.0	12.0	80.6
3	97.0	3.0	79.7
4	98.0	2.0	74.3
5	100.0	-	72.2
Average of Firms	96.0	4.0	76.5
Canning			
1	98.0	2.0	59.6
2	100.0	-	58.7
3	100.0	-	48.4
Average of Firms	98.0	2.0	56.0

As seen from the table above, raw material costs account for 77 per cent of the ex-factory costs in freezing and 56 per cent in canning. For large or small firms, with

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11/ Source: Field Survey

or without boats, these costs are high, ranging from 72 to 80 per cent in freezing, and 48 to 60 per cent in canning. While the raw material prices of all varieties are rising rapidly, the finished product prices of the smaller counts which account for more than 50 per cent of Indian exports, have declined substantially since 1965. The decline in the prices of canned products has been comparatively less on account of the larger share of packing costs, especially cans, in the total ex-factory costs..

Increases in the prices of raw material are however not peculiar to India alone. Even in the United States the prices have been rising rapidly in the recent past. As can be seen from the Table B-12, the prices of raw materials in US have registered an increase of 40 to 70 per cent between 1966 and 1969.

To the extent the firms rely on their own boats for acquiring the raw material, any rise in the raw material prices in the open market does not affect them. However, the number of firms possessing fishing fleets large enough to meet their full requirements is very small. As can be seen from the preceding table catches made by processors' own boats account for an average of only 4 per cent of the total raw materials used in freezing and 2 per cent in canning. For more than 95 per cent of their needs, the firms have to compete in the open market along with the large number of other firms.

Table B-12

Average Ex-vessel Prices of Shrimp per lb.
US Cents from Gulf States (Head - off) 12/

Counts	1956	1960	1965	1966	1969
Under 15	75	72	92	112	158
15/20	71	67	85	103	150
21/25	67	59	76	97	132
26/30	56	54	69	92	122
31/40	52	47	60	81	100
41/50	42	40	52	70	90
51/67	35	33	49	57	70
67/over	28	26	29	37	65

12/ Source: IIFT Survey Team

Organisation of the Raw Material Market. The existing arrangements for the procurement of raw materials from open market also contribute towards high prices and costs. The firms purchase directly from fishermen, peeling contractors or through agents. Since most of the fishermen are scattered in villages, a system of sales and distribution through middlemen as agents has come into vogue. The Survey reveals that 95 per cent of raw material purchases are made through the middlemen, as can be seen from the following table:

Table B-13

Source of Raw Materials Purchese 13/

(Value in Rs)

	Agents	Fishermen	Peeling Sheds	Total
Total purchase of 13 firms	33,376,311	1,303,084	163,260	34,842,655
Percentage	95.80	3.70	0.50	100.0

The fact that middlemen engaged in raw material supply also take their share by way of commission or profits, raises the ultimate prices still further. In

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13/ Source: Field Survey

Kerala, the agents charge 10 paise per kg. or 5 per cent of the value of purchases as commission. The tendency on the part of the agents to exploit the shortage situation by making processors bid against one another can be countered if the processors fix a price among themselves for the day for each variety. A voluntary experiment in this direction which was tried in 1966 by a few Cochin firms did not prove a success as most of the buyers who were a party to the agreement could not avoid the temptation of secretly obtaining a larger share of the market by offering slightly higher prices by violating the agreement. In Mangalore, the efforts of the South Kanara District Cooperative Fish Marketing Federation to distribute catches at a fixed price have been quite successful, as more than 80 per cent of the catch is controlled by the organisation. Such an arrangement would be difficult in Kerala, because of the existence of a very large number of fishermen and processors and the consequent difficulty of acquiring a major share of the catch to effectively control the prices. Hence, organising the fishermen through one or more cooperatives has not been tried.

Prices of raw materials also rose on account of the devaluation of the rupee. The increased realisation in terms of rupee due to the devaluation meant an increased capacity to pay for raw materials by the processors. This led the agents and middlemen to raise the minimum prices to share the benefit, thereby raising the cost of the raw materials.

Purchase Tax. The raw material cost of the industry is further increased by purchase taxes imposed by some of the State Governments. Maharashtra Government charges 2 per cent purchase tax on froglegs, while Kerala Government has imposed a 5 per cent purchase tax on prawns. The Survey reveals that the latter accounts for 2.3 per cent of the total raw material cost for certain selected firms which were interviewed by the Survey Team. The entire impact of this tax falls on the processors. The Indian exporter cannot pass the incidence of this tax on to the consumer as the price of the finished product is decided by the importing countries.

Handling of Raw Material. Materials supplied by own boats and purchased directly from the landing centres are brought in whole form to the peeling sites of factories in the firms' own or hired vehicles. These are then dressed in the peeling sheds by factory labour on contract basis.

More than 95 per cent of this pre-process preparation is now done in these primary processing centres. These are owned invariably by private parties who enter into contracts with processors. Ice required for preservation of the raw material is provided by the processors. The head-on raw material, after beheading or peeling and deveining, is washed in water and kept in ice to be transporte later to the factory. Firms are increasingly getting peeling and deveining done on contract or on piece rate basis because of the labour difficulties facing the processors. This is a labour-intensive activity largely undertaken by female workers. Firms having their own peeling sheds have to employ a large permanent labour force involving comparatively higher costs in wages and other benefits such as provident funds, medical aid, etc.

The major problem, however, is of the sanitary and hygienic conditions in the peeling sheds. The top ranking firms take special care of the quality of the raw materials by employing own technical staff at the peeling sheds for supervising the pre-process preparation of the raw materials by using stainless steel vessels, making available sufficient quantities of ice and water and by resorting to regular cleaning schedules using approved detergents and disinfectants.

It is estimated that on an average about 8 times the weight of water per tonne of material is required in the peeling sheds for the different operations including washing of the dressed material to remove slime and dirt and washing of the premises and utensils. Thus a peeling shed handling, on an average, two tonnes of material per day will require a minimum of 16 tonnes of water (approximately 4,000 gallons). As protected water supplies are not generally available to some of the peeling sheds, which are situated away from townships, their water requirements have to be met either from tubewells or artesian wells.

Most of the peeling sheds are not built to any specific design, to regulate an even flow of materials and are found to be lacking in hygienic conditions. These units are not subjected to any control and inspection. Enforcement of a proper design with regulations for sanitary conditions, water supply and personal hygiene of such establishments are urgently needed to ensure production of quality goods. The minimum hygienic requirements for peeling sheds recommended by the Central Institute of Fisheries Technology are given in Annexure II-A. The CIFT has also developed a design for a peeling shed Annexure II-B, with adequate building, storage rooms, utensils, drainage and disposal facilities, fly control, lighting, and other facilities. It is necessary to lay down certain regulation for adopting the design.

Quality Control and pre-shipment inspection are undertaken by the Department of Fisheries in Canada, Korea and Thailand, by Special Fishery Boards in UK and Netherlands, Fishermen Sales Promotion Organisations in Norway and Denmark and Fishermen's Associations in Japan and by Food and Drug Administration in United States of America with the close association of Bureau of Commercial Fisheries. The inspection in India should also be made as compulsory inplant inspection right from the landing of raw materials to the marketing of the finished products.

2.2 Processing Methods

i) Freezing of Prawns. In prawn freezing operations only three major typ es of products are processed in India. These are (i) the headless shell-on type; (ii) peeled and deveined fresh frozen, and (iii) the cooked frozen types. In all the three types, the materials are packed in 5 lb. solid blocks using water as glaze.

Preprocess Preparation. The raw materials, fresh or iced, are initially washed in chlorinated water before removal of head and shell in the primary processing centres known as peeling sheds. The beheaded or peeled and deveined prawns are then washed thoroughly in small quantities of 12 to 15 kgs. each in several changes of chlorinated water, after which they are iced and kept for onward transportation to processing factories. In India peeling, beheading and grading for size are done manually, unlike in some of the overseas countries where mechanisation is widely practised.

Freezing. The prepared raw material is brought to the factories for grading and freezing. The material is graded according to size and packed separately for different types of pack. Prawns are packed into three major types.

i) Headless - shell-on (HL)
ii) Peeled and deveined (P&D)
iii) Cooked and peeled (CP) or cooked peeled & deveined (CPD)

In the last mentioned item, the whole raw material (in the case of CP) or the peeled meat (in the case of CPD) are given a precook in 5 per cent boiling brine in flowing steam for 1 minute followed by dip in brine solution, before sorting and grading for freezing. The graded material is then packed in 5 pound quantities in trays or in cartons as the case may be. These are then taken to the freezers for quick freezing at -40°C, after adding sufficient amount of glaze water ranging from 1¼ to 2 pounds for every 5 pound block.

Freezing Equipment. Freezing is done in contact (plate) freezers in almost all the establishments. Usual range of freezers used are:

Jackstone	Junior	360 lbs/charge
Jackstone	Senior	700 lbs/charge
Amerio	Junior	360 lbs/charge
Amerio	Senior	700 lbs/charge
Other makes	-	2,200 lbs/charge

All these types are at present imported, as plate freezers of the right quality are not yet manufactured in India. Units assembled in India have not so far proved as efficient as the imported ones. Freezing time in these plate freezers varies from 1 hour to 3 hours. Blast freezers available in three or four freezing factories in the country are not found to be quite suitable for block freezing as under this kind of freezing the blocks have a tendency to bulge out.

After freezing, the trays are dipped in water to remove the blocks from the plates (this is not done in the case of carton freezing) and put into 5 lb. waxed cartons lined with polythene inside to cover the block completely, ten of which are then packed into a master carton. The usual sizes of waxed cartons and master cartons used by the trade are as follows:

Size of Waxed Cartons	Size of Master Cartons
31 cm x 16 cm x 6 cm	32 cm x 32 cm x 33 cm
30 cm x 18.5 cm x 5 cm	32 cm x 53 cm x 21 cm
31 cm x 16.5 cm x 6 cm	37.5 cm x 31 cm x 28.7 cm
28 cm x 20.1 cm x 9 cm	33 cm x 30 cm x 32 cm
28 cm x 20.2 cm x 8.2 cm	33 cm x 33 cm x 32 cm
31 cm x 15.5 cm x 6 cm	41.5 cm x 29 cm x 28.5 cm
31 cm x 15.6 cm x 6 cm	32 cm x 32 cm x 32 cm

The average weight of the waxed cartons ranges between 55 and 88 grams. The prices of cartons vary between 36 and 72 paise each, depending on the quality of the board used for their preparation. Whenever the margin between the ex-factory cost of the product and the selling price gets narrower due to the rise in the price of raw materials, there is a tendency on the part of the exporters to compensate themselves to some extent by use of cheaper cartons. This results in lack of uniformity in the packaging and consequently a poor image even of the otherwise good products.

Processing Methods in Other Countries. Although the methods of freezing employed in India are similar to those followed in other shrimp processing countries, the types of pack differ considerably. While most of the foreign countries have adopted different packing methods to suit market requirements, Indian producers still adhere to the traditional block freezing. In USA all the bigger sizes of shrimp are processed in the individual quick frozen form. The same is the case in Mexico and Central and South America whose main selling market is USA. The system followed for handling and processing of shrimp in these countries is indicated below:

Handling of Shrimp on Vessels. All fishing vessels have insulated fish holds, the larger sizes (72' and upward) having either brine chilling tanks or freezing facilities. The smaller boats carry ice and pack the shrimp in boxes/plastic containers, while the boats fitted with brine chilling tanks store them in the tanks at temperatures just below 0°C (but not lower than-1°C) and the bigger boats (over 85 in length) fitted with freezers quick freeze the raw material in tanks and store them in the frozen storages provided in the vessels.

In all these cases, the shrimp is washed well in sea water, beheaded, washed again and stored in the manner indicated above. All the shore plants have fully automatic lines served by a grading machine which includes an inspection belt costing approximately $ 35,000; peeling and deveining units valued at $ 4,700 per unit which can handle one shrimp per second and continuous tunnel freezing units costing approximately $ 65,000; breading and battering machine (feeding belt and two sets each of breading and battering assembly) valued at $ 20,000 and automatic carton forming machine, costing $ 75,000. The continuous tunnel freezing assembly freezes the cooked fish sticks in 40 minutes, while ordinary IQF products take approximately 25 minutes.

The raw material (ungraded) brought in by trucks is delivered into bins containing water and is conveyed by winged ratators on the conveyors where the material is sprayed with chlorine water of 200 ppm. while moving. The material then passes on to the inspection table where damaged and discoloured pieces, if any, are separated and then conveyed to a set of three graders, each one adjusted to separate two grades each, the first two smallest grades and so on, thus separating the entire lot into 7 grades. The graded material is collected in big tanks mixed with flake or crushed ice and stored at -1°C in the chill storage or on to the lines if immediately required for freezing as HL.

For preparation of fantail breaded shrimp, the raw material is received in the peeled condition by the firm. The material is fed on to three different lines. In each line the well arranged individual fantail shrimp is passed through 3 sets of battering and breading machines in a row (with a view to ensure maximum permissible breading viz. 48 per cent by weight of the breaded shrimp). The breaded prawns then pass through a blower type tunnel freezer, where they are frozen hard to -40°C in 25 minutes. They are then packed in 2 lb, 1lb, and 10 oz packages (waxed cartons) by hand and the packages are then sealed and over-wrapped by labels by automatic machines. The individual cartons are then packed in master cartons and stored at -20°C.

For the P&D IQF preparations, the meat is arranged individually in thick plastic trays, and frozen in Americ freezers. The trays have the same length and breadth of the ordinary Amerio trays but without partitions and with height a little less than half, so that two trays can be inserted in place of one. It is estimated that the quantity that can be charged at one time by individually arranging them is reduced to nearly one-third compared to block freezing but this is compensated by the quicker freezing of the material. The trays are floated in slightly warm water at 1 to 2°C for a few seconds to facilitate easy removal of the pieces from the trays and the pieces are shaken on to a conveyor from where they are packed into cartons. The open cartons are then passed through a fine spray of water, closed and inverted and then passed through the scaling and labelling machine.

Most of the Mexican plants however pack IQF shrimp direct into the 40 lbs. master cartons having a plastic lining inside. These bulk packs are reprocessed into breaded shrimp products by the importing firms is USA. Similar methods are adopted by the shrimp trawlers operating from most of the Central and South American countries in the Caribbean Sea, Gulf of Mexico and South West Atlantic ocean.

Cost of Production. As has already been mentioned earlier, nearly 80 per cent of the ex-factory cost on an average is made up by raw material cost. As the cost per unit weight of raw material is more in the case of larger sizes of raw material which are processed into headless form, the cost of processing, which remains more or less the same in the case of all types of packs, will show itself to be relatively less than the average figure give above.

The 1968 average for six factories given below shows the average expenditure for freezing and packing one pound of shrimp as 30 paise per pound, the outward freight to USA, customs charges etc costing another 65 paise per pound.

Average Cost Involved in Freezing of 50 Pounds Prawns as in 1968

Processing Charges

Ice	Rs 0.25
Master cartons	Rs 2.30
Waxed carton	Rs 3.50
Polythene	Rs 0.70
Strapping	Rs 0.80
Labour for packing, electricity, water, plant depreciation	Rs 7.50
Total	Rs15.05/ 50 lbs = 30 pa

Outward Transport
(to U.S. Ports)

Freight	Rs 30.00
Customs charges	
Cess, Inspection charges	Rs 2.50 32.50 ÷ 50 = 0.65/l
Loss by sampling	
	Rs 47.55/50 lbs or say Re 1.0 per lb.

As against this, the processing cost in USA and Mexico for freezing and packing as made available by the trade is on an average 7½ cents (equivalent to 56.25 paise) per pound including labour, ice requirements, cost of packing materials etc. It will be seen that the cost of processing is much less in India. The freight costs are however high and place a heavy burden on the Indian industry vis-a-vis their competitors.

ii) Freezing of Lobster Tails. The lobster tails are transported in ice to the factories, where these are washed several times in clean water, wrapped individually in moisture proof film and quick frozen at -40°C. Plate or blast freezers are employed for freezing blast freezers being more convenient because of the irregular shape of the material.

Grading is done either before or after freezing into the following sizes:

Super Jumbo - Above 340 g/tail
Jumbo - 285 - 340 g. "
Large - 225 - 284 g. "
Medium - 170 - 224 g. "
Small - 110 - 169 g. "
Extra small - 50 - 109 g. "
Tiny - Below 50 g. "

Grading is also done by colour into snow white and light pink to deep pink. The above classification of grades is based on the standards formulated by the ISI for this commodity (IS 3892 of 1968).

iii) Freezing of Froglegs. India's annual frogleg exports average between 450 and 700 tonnes. The main markets are USA, France and Belgium. Counts upto 80 per kilogram are allowed to be packed, the bigger size grades being exported to USA while the smaller varieties are sent to France. Different size grades packed are as follows:

2-4/lb
4-6/lb
6-8/lb
9-12/lb
12-16/lb
16-20/lb.
21-25/lb.
26-30/lb.
31-35/lb.
-do -

The main centres of processing and export are Bombay and Cochin, each contributing about 50 per cent of the total exports.

Collection of Raw Material. Live frogs are caught from water logged areas in Kerala, Tamil Nadu, Andhra Pradesh and Mysore States. These are taken to common centres for cutting. The hind legs are cut skinned, washed free of blood, packed in ice and transported to the processing factories. The method adopted is found to be crude and unhygienic. The slime on the body of frog has been found to harbour million of bacteria and to contaiminate the cut legs contributing largely to high bacterial loads in the finished product. The methods of butchering itself in certain places in India has been condemned as an inhuman act. An alternate process has been evolved and suggested to the trade by the Central Institute of Fisheries Technology to avoid both the defects. In this process the live frogs are dipped in a 10 per cent solution of common salt for 10 minutes. The frogs get paralysed in a short time whereafter the separation of legs becomes easy, and the surface slime is almost completely washed off from the body of the frogs. The legs are then skinned as usual, dipped in chlorinated water and packed in good quality ice before transporting to the factories.

Method of Freezing. The legs are again washed four times in chlorinated water having a residual level of 5 ppm. chlorine and given a final dip in water containing a chlorine residual of 10 ppm. for 10 minutes according to the new technique. After draining, the legs are individually wrapped in polythene wraps which are secured by rubber bands, arranged in trays individually and frozen at -40°C in plate freezers.

Freezing of froglegs can also be done in blast freezers. After freezing the individual legs are packed in 5 or 10 lb. cardboard cartons lined on the inside with polythene sheets. The cartons are stored at -17°C until shipment.

Recently the Central Institute of Fisheries Technology has suggested an alternative method to the trade in view of the practical difficulties experienced by it in effectively introducing salt treatment in the cutting centres. The legs are brought in the skin-on condition to the factory in ice. The legs are dipped in salt solution followed by skinning and subjecting them to treatment as per process given above. It has been found that this method gives the same efficiency in maintaining low bacterial load in the finished product. Standard specifications have been laid down by the ISI in respect of frozen froglegs (I.S. 2885 - 1964). The product has also been brought under compulsory pre-shipment inspection, bacteriological specifications having become compulsory only with effect from 1st October, 1969.

iv) Freezing of Fish. India has started exporting frozen fish, mainly pomfrets either in whole or fillet form from Bombay since 1963. In view of the attractive demand for various types of fish either in whole or fillet form in Europe particularly France, Australia and Singapore fishes like tuna, shark, threadfin, sole, sardine and other varieties can be considered for future development. These may be frozen whole, or in fillets or in blocks according to demand.

The technological aspects of problems like the amenability of each variety of freezing as whole or in fillets, the prevention of belly bursting in sardines etc. have been investigated by the CIFT for the benefit of the trade. The special problem of belly bursting in sardine has already been solved by the CIFT, which has recommended a pretreatment in 15 per cent brine before freezing.

Trial production and marketing of fish fillets from various varieties of fish has been attempted by the Indo-Norwegian Project at Cochin. Data on yield and cost of production for each variety have been worked out by the Project, as given Table B-14.

Fish freezing industry is highly advanced in some of the freign countries visited by the Survey Team. In Canada many large units have been established for handling ground fishes like cod, haddock, pollock etc. All pre-process operations like beheading, filleting and skinning are done by machines, the first two machines being used only by larger factories where the daily production averages 200,000 pounds of whole fish. In other units beheading and filleting are done by skilled labour. However skinning is done invariably by machines in all the units.

In Norway, most of the sardine catches intended for canning at a later date are frozen immediately. During seasons of abundance some of the firms have their own freezing trawlers which buy sardines in the high sea from the fishing vessels, freeze them immediately and store them in their plants on shore to feed the sardine canning units over the year for fuller utilisation of the canning

Table B-14

Cost of Production of Frozen Fish Fillets

Name of fillet	Quantity of raw fish Kgs	Yield (Product) Rs	Price of Raw Fish		Wages (Actual) Rs	Handling etc. charges Rs	General O.H. Rs	Depreciation of filleting machine Rs	Packing Rs	Freezing charges Rs	Price at Project Rs
			Rate Rs	Amount Rs							
Deep Sea Fish (Chlorophthalmus)	444	334 lbs	0.07	31.08	100.26	62.16	23.25	-	83.50	7.50	$\frac{307.75}{334}$ =0.92
Ruby fish	846	947 lbs	0.07	59.22	144.00	90.44	33.75	-	124.25	11.25	$\frac{462.91}{497}$ =0.93
Shark	41	21 kgs	0.72	29.52	3.50	5.74	6.15	2.00	3.00	1.05	$\frac{50.96}{21}$ =2.43
Tuna	105	67.5 kgs	0.65	68.25	14.00	14.70	15.75	4.00	8.00	3.38	$\frac{128.08}{67.5}$ =1.90
Ray slices	1,000	475 kgs	0.50	500.00 less price of waste Rs 52.00 i.e. 448.00	55.50	80.00	150.00	-	-	23.75	$\frac{757.25}{475}$ =1.60

Source: Indo-Norwegian Project, Cochin

plant for a longer period. Further, the large fish like cod and haddock are frozen for markets in Europe and USA. The trimmings from the fillets are also block frozen for the purpose of manufacture of fish sticks.

In Poland the landings of distant water fleet are filleted and frozen for consumption within the country and for export to selected markets in USA, Canada and Europe. Trimmings from the fillet line are packed in blocks and frozen for use in the production of fish sticks.

On the production line fresh fish unloaded from the fish holds are flumed with a spray of water and led to the cutting table. The head and viscera are removed and the fish cut into two fillets by hand. The fillets are then conveyed on to the 'Baadar' skinning machines and the skinned fillets flumed to an inspection table. After inspection the fillets are passed through a dip tank and then conveyed to the trimming and packing tables.

On the cooked fish product line blocks of frozen fish are cut in three operations into sticks. The sticks are automatically conveyed to the input belts of the green

Libra Batter and Breading machine. The breaded fish sticks pass into a 38" wide Max Beth continuous frier wherein oil is kept at 180°C. The fried sticks pass through a cooling tunnel, from where they are conveyed to the packing and automatic check weighing machine.

v) Freezing of Turtle Meat, Crab Meat, Clams, Mussel etc. Turtle and crab meat are already being exported, though in very small quantities, their annual exports not exceeding 1 tonne and 11 tonnes respectively. No concerted effort has so far been made to study the technological or commercial aspects of these two items.

The Chesapeake Bay crab fishery has been organised on an industrial basis in USA and the crab meat is packed and processed for different packs of convenience foods to meet the special markets in North America. Similarly, Mexico has recently started processing crab meat for the US market. It is, therefore, possible to take advantage of the growing market in USA, Europe and Japan for this product. Similarly freezing of clam or mussel meat has not been attempted so far.

vi) Canning of Prawns. All the canneries are batch operated and follow the conventional processes of blanching in brine, cooling, filling in cans, addition of brine, exhausting, seaming, sterilization and cooling in the manufacture of the product. However, there are minor variations in the techniques employed from unit to unit.

Blanching. Blanching is done in boiling brine of strength varying between 7 and 12 per cent for periods ranging from 3 to 5 minutes depending on the size of the prawns. The ideal condition for blanching has been prescribed as 7.0 per cent brine for 5 minutes, when the blanched meat is expected to attain equilibrium moisture content. Over-blanching in an overstrength brine results in meat getting less moisture than the equilibrium level while the reverse is the case with under-blanching.

Draining and Cocking of Blanched Meat. The blanched meat is cooled either by dipping the blanched meat in chilled water or by spreading the meat on a perforated table under a fan. The two techniques have their own merits and demerits. Cooling is quicker in the former operation but this at times upsets the residual moisture level of the meat. Chances of contamination are also more. Cooling is slower in the second type of operation but chances of external contamination are very much less.

Filling. Filling into containers is done by hand. If ideally blanched and properly drained the weight of meat filled is the same as that of the desired drained weight. In case the material is over-blanched, lesser weight is filled to allow for absorption of water within the can during the process of equilibrium. Likewise in under-blanching more material is filled to compensate for loss of moisture within the can.

Along with the material hot brine of strength 2 to 3 per cent is also filled into the can. Although ideal canning conditions limit the volume of brine to be added to each type of can so that a headspace of at least 1/8" height is available, canners do not follow this strictly but resort to filling the can until it overflows. (The quantity of brine required to be added to a can of size 301x206 is 80-85 ml.)..

Exhausting. Exhausting to remove all occluded air from the cans is done by keeping them in an atmosphere of steam for 6 to 8 minutes. This is done either in chain type or in box type exhausts, the former being considered better as each can receives uniform heating.

Seaming. Seaming is generally done by power seamers in almost all units. The most popular type of seamer used is the MBIA seamer supplied by M/s Metal Box Co. of India. Larger type seamers supplied by the same firm are also in use in at least three of the major canneries in the country.

Grading. Blanched and cooled meat is graded into different groups as follows:

	Count/100 g.
Supreme Jumbo	8 and less
Jumbo	9 - 13
Large	14 - 22
Medium	23 - 36
Small	37 - 63
Tiny	64 - 102
Cocktail/Mini/Salad	103 and above
Broken	Any pack showing more than 10 per cent broken pieces by weight.

Grading according to the system given above was made compulsory with effect from 11th March, 1969. Prior to this, the lowest grade was Tiny, the count of which was designated as '85 up'/142 g. Absence of an upper limit to the count for Tiny caused confusion in the selling market, as processors began packing counts upto 300 and 400 for 5 oz. pack under the size grade Tiny. Even under the new regulations in force, the count specification for cocktail/Mini/Salad is 103 and above per 100/g.

Retorting. Retorting is done at two temperature levels viz. 239.5° and 249.7°F (10 lbs and 15 lbs pressure of steam). The ideal condition of this process is lower temparature and short time. A retorting time of 22 to 30 minutes at 10 lbs pressure is found to be adequate for 4½ or 5 oz. pack in 301 x 206 cans. Small increase in retorting time is allowed for packs of bigger sizes like small, medium, large and jumbo.

Cost of Production. In the case of canned prawns the expenses on cans, labels, labour, transportation, fuel etc. work out to about 50 per cent of the ex-factory price of the finished goods. Of this, nearly 20 per cent is due to cans and labels while about 11 per cent represents purchase tax, commission to middlemen or suppliers and cost of transportation to units.

vii) Canning of Sardines. The fish are washed thoroughly to remove slime, dirt etc. The head, fins, tails, scaless and viscera are removed. All these operations are done manually. The gutted and beheaded sardines are washed several times using plenty of potable water.

Processing. The fish is immersed in 15 per cent brine for 15 minutes and later drained well. These are then packed into clean lacquered cans leaving a head space of about 1/8". Approximately 5½ oz. of sardine can be packed in the 301 x 206 cans. The cans are kept upside down on perforated trays for cooking at 5 lb. steam pressure for 35 to 40 minutes. (Cooking can also be done in flowing steam in which case the cooking time has to be increased to 60 minutes or more depending on the size of the individual pieces).

After cooking, the cans are filled with refined vegetable (groundnut) oil heated to 85°C. The filled cans are exhausted in steam exhaust for 8 to 10 minutes. The cans are sealed immediately before cooling and retorted for 60-65 minutes at 15 lb. steam pressure. Immediately after processing, the cans are cooled in flowing water in a cooling tank. The outside of the individual cans is washed well to remove oil and other impurties, dried and stored in a cool dry place.

This method has been found to turn out a very satisfactory product meeting all the specifications laid down for such products, both in India and in the other producing and importing countries of the world. However, Indian canners depart very often from the standard technique detailed above with the result that the products become sub-standard. The major defect relates to the presence of higher percentage of water in the can with precooked meat which causes disintegration in the product and shortens its overall shelf life. In order to speed up the canning operations and to reduce the overall cost, canners very often pack the sardines directly into cans after brining without a precook. The free water which would otherwise have been drained off during precook remains in the can and gets mixed with the oil during the retorting stage.

Cost of Production

Packing in 301 x 309 cans (per case of 48 cans)

Cost of raw material	Rs 15.00
Cist of oil	Rs 18.00
Labour & Processing charges	Rs 15.00
Cost of can	Rs 14.00

Labelling charges including label	Rs 1.50
Cost of wooden case	Rs 2.00
Total	Rs 65.50

Packing in 301 x 206 (per case of 48 cans)

Cost of raw material	Rs 10.00
Cost of oil	Rs 13.00
Labour and Processing charges	Rs 10.00
Cost of can	Rs 12.00
Label charges	Rs 1.50
Cost of wooden box	Rs 1.80
Total	Rs 48.30

Packing in 1/4 Dingley cans (per case of 100 cans)

Cost of raw material	Rs 15.00
Vegetable oil	Rs 17.00
Labour & processing charges	Rs 13.00
Label & Packing charges	Rs 8.00
Cost of Wooden case	Rs 2.00
Total	Rs 55.00

Machinery Requirements for Large Scale Production. In large scale canning operations the beheading, gutting, descaling and washing operations should be handled by machines. This will reduce the cost of production and increase the operational efficiency. Seaming machinery suited to the shapes, rectangular or round, and sizes of the cans used will also have to be made available.

viii) Canning of Mackerel. Mackerel, like sardine, is also packed only for internal consumption in India. Packing is done in A1 tall cans.

Processing Method. The processing method is similar to that of canning of sardines. The head, tail fins and en-trails are removed followed by thorough washing. Brining is done in 15 per cent sodium chloride for 25 minutes followed by a precook by one of the methods indicated below:

(a) Cooking the fish in an autoclave at steam pressure of 5 pounds for 40 to 50 minutes after arranging them in aluminium of G.I. wire baskets; or

(b) Cooking the fish after packing in cans at 5 pounds with the cans inverted on perforated grids in the autoclave. A further draining of the free liquid is done after exhausing to ensure complete removal of all free water. Filling of oil and retorting are done as in the case of sardine, the minimum retorting time for A1 tall cans being 60 minutes at 15 pounds.

Cost of Production (per case of 48 cans of Al Tall)

Cost of mackerel (at average of 8 mackerels per can)	Rs 48.00
Cost of oil	Rs 24.00
Labour charges & processing cost	Rs 13.00
Cost of can	Rs 17.00
Labels	Rs 1.50
Cost of wooden case	Rs 2.00
Total	Rs105.50

Other Packs of Sardine and Mackerel. A variety of other popular products can be prepared from sardine and mackerel for the export markets. Sardine and mackerel in tomato and other sauces are very popular in USA, Canada and the European countries. Some of the sardine canneries in India are already manufacturing 'sardines in tomato sauce' for sale in internal markets. The possibility of freezing sardines, mackerel and seer fish during the season should be studied immediately to feed the canning factories especially in some centres in Kerala, Mysore, Goa and Maharashtra. Such freezing will assist the canning plants to get a continuous supply of raw material at a reasobale cost for working plants for a longer period.

ix) *Canning of Tuna*. A longitudinal cut is made in the belly ofthe fish to remove viscera. The head is removed and the remaining portion of the fish is either cut into pieces of suitable sizes or used as whole, if small in size for the subsequent cooking. The eviscerated/cut pieces are washed well in several changes of clean potable water.

The cleaned fish are placed in shallow wire baskets which are then arranged on trays and cooked in a cooking chamber of autoclave by steam. A steam pressure of 10 pounds may be used and a cooking time between 1½ to 2 hours depending on the size of the fish or chunks used.

The skin is scraped off and the meat split open along the vertical line of the backbone. The bones are removed and the meat once again split open along the vertical line. At this stage black meat, if any, is to be removed carefully. The loins left over may be polished by scrubbing off the loose fragments.

The loins are cut to the size of the containers. The pieces are then brined in a 15 per cent salt solution containing 0.07 per cent sodium bicarbonate for 20 minutes.

The pieces are drained and packed into clean containers. Approximately 5½ oz. of meat can be packed into the 301 x 206 cans.

The required quantity of hot oil (for solid pack only very small quantities of oil of the order of 6-10 m. is required) is added and the filled cans are sealed and thoroughly sterilized for one hour at 15 lb. steam pressure.

Subsequent precautions are the same as in the case of all other oil packs.

Cost of Production (per case of 48 cans of size 301 x 206)

Cost of raw material	Rs 30.00
Cost of oil	Rs 12.00
Cost of cans	Rs 12.00
Labour & Processing charges	Rs 25.00
Label	Rs 1.50
Wooden case for packing	Rs 2.00
Total	Rs 82.50

x) Canning of Pomfret. The washed raw material is beheaded, descaled and its fins, tail tips and viscera are removed. These are then washed again in clean water before bringing in cold brine of 15 per cent strength. The fish are then cut uniformally into suitable sizes and packed, preferably in lacquered cans, ensuring that there is not more than one tail piece present in any can. Hot refined vegetable oil is filled in the can which is then sealed and retorted at 15 lbs pressure for 45 to 50 minutes.

Complementary Inputs and Services

Supply of Ice. Ice is required for preservation of raw materials in fishing boats, during transport to peeling sheds and to the processing units. For the quality processed at present in the country, the total requirements of ice is estimated at 300 to 400 tonnes per day. If all the processing plants run at full capacity, the ice requirements would work out to about 1,500 tonnes per day. The quantity of ice available at present is about 800 tonnes per day, 490 tonnes in the public sector and 300 tonnes in the private sector. Thus the present ice production is sufficient to meet the requirements of current production. However, it is too short to meet the full demand of theprocessing plants, if they were to work to their full capacity.

A major portion of small mechanised boats generally do not carry ice. Many a time the expected quantity of ice does not arrive before sailing and the boats have to go for fishing without ice. Ice is also not used by some on considerations of its cost.** To avoid wastage and for better preservation of the quality of raw materials, it is necessary that adequate quantity of ice at reasonable cost is made available to small fishing boats.

Cold Storage. Only a few major processors have adequate space to store frozen marine products. With an increased number of exporters dependent upon hired processing facilities, the need for more cold storage capacity has to be met in Cochin and Bombay. Lack of frozen storage facilities for in-transit cargo at the Cochin port poses a major problem. If a consignment of frozen goods is shut out for some reason or other, it has to be carried back to the storage of the shipper, which in some cases may be away from the port. Frozen storage facilities need to be provided alonside the wharf or near the port area by the port authorities or private agencies. The need for marketing frozen products within the country and outside has to be appreciated by establishing frozen storages in important landings centres. Such frozen storages can be established on a commercial basis like wharehouses for fruits and potatoes even by separate

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** The average purchase price of ice in Kerala has been Rs 45 per tonne in 1968-69. Major processors often paid as high as Rs 70 per tonne in Cochin, Rs 130 in Bombay and Rs 150 per tonne in Goa, during the peak season and in summer.

agencies not directly connected with fishing. Such an organisation along with a fleet of insulated/refrigerated trucks will be commercially viable.

Recent Technological Advances in Processing. Apart from mechanisation at various stages of production, and improved methods of production of fishery products under hygeinic conditions, many new findings have been made in the field of fish freezing, canning and accelerated freeze drying.

1) In the field of freezing, continuous fluidized belt freezing (both single and double pass system) has become popular in the United States for preparation of individually quick frozen (I.Q.F.) products. These machines have the advantages of (i) lower initial installation costs, (ii) portability and ease of expansion, (iii) ease of control and sanitation, (iv) standard interchangeable parts, and (v) corrosion resistant material that make painting unnecessary.

2) Another modern freezing system is one employing polar stream refrigeration using liquid nitrogen as refrigerant. Units are available for use on board small fishing vessels, on trucks, rail vans etc. Thermo king units, usually used in trucks for transport of frozen

fishery products, cost approximately $ 4,000 to $ 6,000 while polar stream unit for the same purpose costs only $ 2,500. The latter has a higher operational efficiency with a comparatively low cost of operation, but in the long term its maintenance costs are higher as the refrigerant (liquid nitrogen) cannot be recovered and used again.

3) Accelerated freeze drying is yet another technique in which a lot of experimental work has been done in many countries including India. It has been found effective in the case of leafy vegetables mushrooms, onions etc and the studies conducted so far give promise of its possible exploitation on a commercial scale for some of the fishery products also.

4) Another field in which notable contributions have been made in India and in countries like Canada and USA, is the prevention of drip loss in frozen fish products. the drip loss is understood to be the direct result of exudation of cell fluids containing soluble components at the time of thawing of the frozen product. Not only does it involve some loss of weight in raw material, but it also causes deterioration in flavour owing to the wastage of soluble flavour compounds in the drip loss.

The actual loss is quite substantial and has been found to be in the range of 3 to 10 per cent in the case of shrimp products, depending on the type of pack, size etc. Fresh frozen prawns in the headless form show an average loss of 5 per cent, while that in the meat form (P&D) show 7 to 10 per cent and cooked frozen 3 to 5 per cent. In the case of froglegs too, the weight loss has been found to be in the range of 7 to 10 per cent.

The general practice is to add arbitrarily an excess weight of 120 to 360 gms to every five pound pack (2.27 kg) in the case of shrimp and between 0.5 to 1.0 kg for every 10 kg pack of froglegs to maintain the declared drained weight level. Based on the total export figures, it is estimated that over 740 tonnes of raw materials for this purpose are needed annually in the case of shrimp alone, as is revealed by the following figures for 1968.

Frozen Prawns

(i)	Excess weight required to be added for P&D of count upto 90/lb. (Total 32,974 kg) at 5 per cent	6,649 kgs.
(ii)	Excess weight required to be added for P&D count above 91/lb. (Total 45,76,223 kg) at 10 per cent	457,622 kgs.

(iii) Excess weight required to be added for cooked (CPD) (Total 1,869,574 kgs) at 15 per cent	2,80,462 kgs
Total	7,44,733 kgs

Canned Prawns

at 5 per cent for 1,759,936kgs.	87,996 kgs

Frozen Froglegs

at 5 per cent for 619,722 kgs.	30,986 kgs

Detailed investigations carried out in India on this problem have brought out many interesting features and resulted in the formulation of a method for the prevention of such weight losses in frozen products. It has been found that a pretreatment of the raw material with 16 per cent solution of a mixture of sodium tripolyphosphate and potassium dihydrogen phsophate in 3:1 ratio is very effective. Details of cost of treatment are given below:

Quantity of chemicals required for treating raw material:	1,000 kgs
(i) Sodium tripolyphosphate	10.8 kgs
(ii) Pot. dihydrogen Phosphate	3.6 kgs
Total cost of treatment	about Rs 75.00
Saving in raw material	100 kgs.

The effectiveness of the treatment at various concentrations and volume of the treatment mixture is indicated in the following table:

Table B-15

Effect of Sodium Tripolyphosphate and Potassium Dihydrogen Phosphate Mixture on Thawed & Cooked Yields

Vol. of Soln (16%) ml per 450 g	Thawed Yield %	Cooked Yield %	Conch. (%) of soln. 40 ml/450 g	Thawed Yield %	Cooked Yield %
0	95.7	44.9	0	92.0	45.5
10	98.9	49.3	10	95.0	52.6
20	98.9	55.3	12	97.7	55.3
30	101.1	58.2	14	100.0	58.7
40	104.2	62.2	16	102.2	61.2
50	104.2	62.7	18	102.2	62.2

It is seen that at 14 per cent concentration and 30 ml per 450 grams of raw material the thawed yield is 100 per cent or above, although a 16 per cent solution and 40 ml. are recommended in commercial operations as a precautionary measure.

15/ Source: C.I.F.T. Ernakulam

This problem is also being confronted by some of the major fish producing countries visited by the Survey Team. Some of the factories in USA and Canada have already started using a patented product of polyphosphates viz. 'Calgon' for preventing 'thaw drip loss' even though the chemical has not yet been officially approved by the US authorities. The acceptance of the treatment is under the active consideration of the Food & Drug Administration of the USA. The Team had occasion to discuss the problem with the FDA authorities in Washington and to apprise them of the scientific investigations carried out in India on the subject. They were convinced that the treatment did not have any deleterious effect on the product and that the maximum amount of sodium, potassium and phosphorus introduced into the material for such treatment is only 330 mg, 100 mg and 350 mg per cent respectively. On the contrary, the treated material gives a superior colour, texture and flavour. It is, therefore, quite likely that the use of polyphosphates may be officially accepted very soon by them also. Similar action should be taken in India also to officially accept the procedure which will ultimately result in saving of raw material.

xi) Dried & Salted Fishery Products. The methods adopted for the preparation of dried and salted fishery products are the same as practised in other parts of the world except that the production in India is carried on small scale cottage industry basis in fishing villages. Salting is done in Government or private curing yards using salt of standard quality. The ratio of salt to fish varies from 1:3 to 1:8 depending on the nature of the fish and type of cure required, higher proportions being generally used in the case of fatty fishes such as sardine, mackerel and seer. The salting period varies from 12 to 18 hours, once again depending on the nature of fish and type of cure. Smaller varieties of fish like anchovies and silver bellies are dried without salting.

After salting, fish are washed in the self brine and dried in the open sun, either on raised platforms, or on coir or palmyrah mats spread on the ground itself. The drying process generally takes two to three days. Mechanical drying is not done in India partly because of the high capital investment involved and partly because of the high tropical heat which facilitates easy drying in the open sun.

xii) Processing of Bombay Duck. In the case of Bombay duck drying is done in a slightly different manner. The fish, after washing in sea water, are locked in pairs at the jaws and hung on ropes tied between poles to be dried in the natural breeze and sun. For complete drying it takes 3 to 5 days depending on the weather conditions. After 3 or 4 days, the fish is removed from the scaffolds and further dried by spreading on the beach. If drying becomes interrupted due to weather conditions, the product starts emitting a strong offensive odour and gets yellowish brown in colour. Drying is effected more quickly with less spoilage, if care is taken to leave a small gap between the adjacent fish.

The dried Bombay duck are made into bundles each containing 2,000 or 4,000 fish. No strict grading is followed. The bundles are tied with thin ropes and transported to Bombay, from where they are exported. No other packing is employed at present. At times these bundles are wrapped in gunny bags.

xiii) Processing of Laminated Bombay Duck. Fresh Bombay duck, usually from the bigger size grades, is washed thoroughly in sea water or potable water to remove dirt and adhering particles and partially dried by hanging on scaffolds as usual, taking care to leave a small space between the adjacent fish to facilitate easy drying. Drying is continued for 6-8 hours during the day time or 8-12 hours during night. The initial drying brings down the moisture content to about 60 per cent from the original 88 per cent and imparts the fish the required hardness.

The head and fins of the partially dried fish are cut off. A deep cut is made along the belly portion and the entrails removed. Similar longitudinal cuts are made with sharp knife and the vertebral column is removed. The fish is then washed in potable water containing 1-2% salt and 0.05 to 0.01 per cent citric acid. The fish is flattened and spread on wire mesh trays or bamboo platforms and dried in the sun till the moisture content is brought down to about 10 per cent. The laminated fish is pressed individually by passing through a roller press. The individual pieces are finally trimmed into uniform size and shape.

Packing. Bundles of laminated Bombay duck are prepared by tying 25 or 50 pieces together. These bundles are put into polythene bags and sealed air tight and then packed into 4 gallon tins or dealwood boxes for export.

In view of the growing demand for dried Bombay duck products in countries like Canada, UK, USA, European countries and Japan, efforts should be made by the processors to improve on quality and packing. Plain Bombay duck can be packed in bulk quantities of 50 kilograms in polythene lined wooden boxes while consumer packs can be made in unwaxed card board box lines with polythene. Laminated Bombay duck, being a speciality product, can be packed only in card board cartons which in turn can be packed in plain wooden boxes for shipment.

xiv) Dried Prawn Pulp. As has already been pointed out, dried prawn pulp is one of the major products produced and exported form India. This product is also prepared on cottage industry basis in shrimp fishing areas in Kerala and Maharashtra. Only small size shrimps are used for drying. The shrimps are dried in the open without salting till the material is hard dried (moisture below 10%) for the local markets. Varieties like M. stylifera, and M. dobsoni which are caught in large quantities in the Kerala area constitute the bulk of raw material which goes into the production of dried pulp.

The raw material in the whole form is cooked in G.L. or tinned copper vessels with just enough water added to produce steam for the cooking process. Small quantities of powdered salt (sodium chloride) are sprinkled over the material in the vat before cooking commences. The material is turned over in the vessel at intervals during the cooking process which lasts till the shell gets separated from the meat. The cooked material is loaded off and spread on coir mats for drying in the open.

The dried material is collected in gunny bags and beaten against a hard surface for separating the shell from the meat. The final removal of the shell and head is effected by winnowing.

As the preparation of the product is done on a small scale basis by individual fishermen, efforts to standardise the process have not so far met with success. In the indigenous process cooking is not uniform, nor does it remove shell particles completely. The incidence of breakage of the prawn pulp is also high.

The product is generally packed in double lined gunny bags for export purposes. With such packing, there is more risk of package breaking up during its transportation and/or shipment. For bulk packing, paper-lined, moisture-proof packets would be more advantageous and attractive. However, smaller packings in 7 pound tins or in polythene bags inserted in corrugated cartons are likely to be more popular in Western markets.

The dried and cured fish industry has been following the traditional methods of processing. No attempt seems to have been made for organising this industry on a factory scale, nor for employing modern techniques for drying and storage. More or less the same situation is reported to have existed in other countries also during the pre-war days mainly because of the cheapness of the dried and salted fish products. But these countries - especially Canada, Japan and Norway, three of the major dried fish producing countries - soon realised that adoption of modern techniques will not only improve the quality of the product but also reduce wastage on account of spoilage, and help maintain uniformity in quality. The above development was also influenced to some extent by the adverse climatic conditions prevailing in these countries which make sun-drying an extremely difficult process.

Mechanical drying is widely practised in all salted fish producing factories in Canada, Norway, UK and Poland. The salted fish are arranged in wire mesh trays and loaded into box-type dryers through which a current of hot air is passed from an outside blower. The temperature of the air thus passed is thermostatically controlled so that the fish does not get cooked in the process. The moisture-laden air coming out of the drying chambers is continuously pulled out by exhaust fans. The position of the drying trays in a chamber is interchanged at intervals during the initial stages of drying, the trays with the material areas left in the open in cold atmosphere for 12 hours in order to help even out the moisture within the meat before further drying is carried out in the dryers.

In India experimental work on more efficient methods of drying has been going on for the past five years at the Central Institute of Fisheries Technology, Cochin, where a batch type tunnel dryer has been designed and tried extensively on local varieties of salted fish like meckerel, sardine, seer, etc. Based on the success of these investigations two types of dryers for commercial use have been designed by the CIFT. Another field in which investigation is progressing is in the use of solar radiation for mechanical dehydration of fish. The suggestion was originally given to the Institute by the FAO, who provided a design based on which a fresh design was prepared by the CIFT.

In the methods of drying also, certain improvements have already been effected which have considerably brought down the drying time from the normal 20 to 24 hour with ordinary mechanical drying. By passing the fish through different regions of progressively higher temperatures during the falling rate period it has been possible to produce a dried product in 8 to 10 hours. This improvement is significant in view of the reported patent method worked out by a British firm, Yarrow & Co Ltd. in collaboration with the Torry Research Station, Aberdeen, using more or less the same principles.

In the case of dried prawn pulp which is also one of the important items of export, no mechanisation has been attempted so far. Traditional methods practised on cottage industry level invariably result in greater wastage by way of breakage and improper or insufficient deshelling. A simple machinery has been designed by the CIFT which helps to avoid these defects and to improve the quality. The machine uses a double walled drum lined on the inside with stainless steel plates. Heating is done by steam at pressure passed through the interspace while the whole prawn is fed into the drum, which is rotated at slow speed. Deshelling is effected by the baffles provided on the inner side of the drum. The machine is found to combine the cooking, deshelling and drying processes in one continuous operation.

Packing is another field in which very little improvement has been made in India. Dried and salted products for exports are even now packed in gunny bags or palmyra leaf mats except in the case of consumer packs of Bombay duck. The use of polythene lined wooden cases, as i done in almost all foreign countries, has not yet been introduced in India due to the additional cost involved.

2.3 Preshipment Inspection & Quality Control

India introduced compulsory preshipment inspection of fishery products for the first time in 1965. Four of the major components of exports namely frozen prawn, canned prawn, frozen froglegs and dried fish have been covered sofar, the first two from March 1965, the third from March, 1966 and the last from 1st April, 1967. The rules governing the inspection of these products were formulated under the Export (Quality Control and Inspection) Act of 1963. So far as dried and salted fish products are concerned, only consignments exported to Ceylon are covered by Pre-shipment Inspection Rules. Maximum permissible moisture and insoluble ash contents have been fixed for different varieties of dried fish besides laying down specifications for organoleptic and visual characteristics. A maximum moisture content of 45 per cent has been fixed for larger sizes of fish like seer, 40 per cent for medium sized fishes like Thynnus, Caranx, Chorinemus and sardines, 35 per cent for small varieties like Arius and Hemirchamphus, 20 to 25 per cent for sun dried prawns and Dussumeria and 20 per cent for sprats. The limit for insoluble ash content has been fixed as 1 per cent in all cases except sparts where the maximum permissible limit is 7 per cent. Details of specifications for individual varieties are given in Annexure II-C.

For other fishery products the pre-shipment inspection rules have not been introduced so far. Specifications have however been formulated for the important varieties of processed fishery products by the Indian Standards Institution. The essential features of the specifications formulated by the ISI appear at AnnexureII-D.A complete list of the specifications so far formulated by ISI is given below:

IS: 2168 - 1962	Specifications for pomfret canned in oil
IS: 2236 - 1962	Specifications for prawn (shrimps) canned in brine
IS: 2237 - 1962	Specifications for frozen prawn
IS: 2345 - 1963	Specifications for dried prawn pulp
IS: 2420 - 1963	Specifications for mackerel canned in oil
IS: 2421 - 1963	Specifications for sardines in oil
IS: 2883 - 1964	Specifications for dried white bait
IS: 2885 - 1964	Specifications for frozen froglegs
IS: 4303 - 1964 (Part II)	Code for sanitary conditions Specifications for dried and laminated Bombay duck

IS: 3892 - 1966	Specifications for frozen lobster tail
IS: 4204 - 1967	Specifications for tuna canned in oil
IS: 4302 - 1967	Specifications for dried salted mackerel
IS: 4303 - 1967 (Part II)	Code for sanitary conditions Handling and transport in fish industry
IS: 4307 - 1967	Specifications for fish meal as live stock feed
IS: 4796 - 1968	Specifications for frozen thread fin

Scale of Sampling for Frozen and Canned Products. For purposes of sampling, according to the present system, it is presumed that the raw material processed into one particular type of product on a day is considered as uniform irrespective of the sources from where it is obtained. where the production rate is small, especially in the case of bigger size groups, a maximum of seven days' production in that particular type of pack could be combined to form a lot. With a view to reducing the sample size further certain adjacent size groups, among which there is generally very little variation, can also be combined. The schedule for drawing of samples from three products namely frozen prawns, canned prawns and frozen froglegs is given in next page.

(Next page)

A. Scale of sampling for frozen prawns

No. of master cartons in the lot	No. of master cartons to be selected
Up to 65	3
66 - 110.	4
111 - 180	5
181 - 300	6
301 and above	7

B. Selection of packing cases for canned prawns

No. of cases in the lot	No. of cases to be selected
Up to 8	2
9 - 25	4
36 - 40	5
41 - 65	6
66 - 110	7
111 - 180	8
181 - 300	9
301 and above	10

C. Selection of Containers for frozen froglegs

No. of containers in the lot	No. of containers to be selected
2 - 15	2
16 - 40.	3
41 - 65	5
66 - 110	7
111 - 180	8
181 - 300	9
301 - 500	10

Note: A 'lot' is defined as the number of cartons in a particular size grade under a particular typ of pack on a single day.

. A comparison of the plan with that adopted by USA shows that the US plan is less lenient to the vendors (processors) than to the buyers. The Indian sampling plan leaves no provision for occurrence of a reject unit in the sample. In the sampling plan of USA the vendors' risk of having an acceptable lot rejected is maintained at 1 in 10, with the buyers' risk of accepting lots that should be rejected being substantially greater. In the Indian plan a lot of 5 per cent defective will be accepted about 80 per cent of the times in the case of frozen prawns. The sampling plan gives less protection for the consumer than the vendor as in USA, because of the small size of the sample inspected for this purpose.

Quality Characteristics. The specifications for frozen prawns, require the products to be examined for size grade, drained weight and flavour besides testing for conformity to nine quality standards as listed below:

(1) Dehydration
(2) Discolouration of shell and meat
(3) Deterioration
(4) Black spot on shell and meat
(5) Broken and damaged pieces
(6) Legs, veins, loose shell etc
(7) Foreign matter
(8) Uniformity of size and
(9) Texture

A scoring system has been adopted (Annexure II-E) in respect of frozen prawns to facilitiate uniform deductions for each defect. Limiting rule is applied to the total deductions scored by the sampled block as also compliance in respect of individual tolerance limits laid down for quality characteristics in deciding the acceptability. In the case of canned prawns, on the other hand, the samples are examined for conformity to characteristics pertaining to the contents and container. In the place of the scoring system, grading for each characteristic is made into 'good', 'fair' and 'poor' below which the sample becomes unacceptable for export. For froglegs also a system similar to the above is adopted.

An analysis of the data so far gathered for frozen prawns using the scoring system, has shown that rejections take place mainly due to excessive deterioration. Although deductions are made in respect of other factors, they are seldom found to affect the over-all rejections except when the defects exceed the individual tolerance limits.

It may be mentioned here that the one day's incubation prescribed in a recent amendment to can specifications is followed only on cans which are offered 14 days or more after production. However, if the product is offered earlier to this, a minimum of seven day's incubation at 37°C is given. This period is however, less compared to the incubation followed by some countries like Canada, where the cans are incubated for a minimum period of one month before sterility tests.

Bacteriological Standards. Preshipment inspection for frozen and canned shrimp, envisaged only physical examination of the products in the beginning. However, with the introduction of bacteriological standards for specific products in some of the importing countries, similar standards have been adopted and implemented for such products in India from time to time. When Australia introduced standards for cooked frozen products in 1966, similar specifications were drawn up for all varieties of cooked prawn products exported from India. Likewise, bacteriological specifications were introduced for frozen froglegs with effect from October 1969 to cover the requirements of the major importing countries of that commodity from India, viz USA and France. The limits set forth for frozen froglegs and those proposed for fresh frozen prawns are shown overleaf.

	Total Plate Count/g at 37°C	E. coli	Salmonella
Fresh frozen HL	500,000	20	Nil
Prawn PD	1000,000	20	"
Fresh Frozen Froglegs	500,000	10	Nil

The above limits meet the existing regulations in almost all importing countries except Japan where a limit of 100,000 for total plate count is set for HL fresh frozen shrimp in a gram.

Inspection in Importing and other Supplying Countries

Mexico. In Mexico which is the world's largest supplier of shrimp to US markets, the State did not have either a quality control or preshipment inspection system. Instead the individual plants exercised their own rigid control to produce goods capable of meeting the importing country's regulations and specifications. They were helped in this respect by the selling organisations which appointed inspectors in each plant to check the quality. The plants are required to pay 1 per cent of the export value of goods towards expenses for this service to the selling organisation. However, in view of the stricter controls being contemplated in the United States, the Mexican

Government have formulated sanitary regulations for all sectors of the shrimp freezing industry. A summary of the regulations governing freezing plants, fishing vessels and the various processes enforced by the Department of Fisheries, Mexico is given in Annexure II-F.

Canada. Canada on the other hand is known to have the strictest form of inspection service in the world. Compulsory inspection is instituted at all stages of operation of processing plants within the country. Likewise all products imported into the country are also subjected to detailed inspection.

Regional and district inspection offices established in key centres throughout the country by the Federal Department of Fisheries man the operation of Inspection service under the authority of the 'Meat and Canned Foods Inspection Act' of Canada. Separate regulations have been passed for inspection of different fishery products like canned and frozen fish, shell fish including clams, oysters, lobsters, crabs, scallops and shrimps, salted and dried fish products, breaded fishery products and speciality products like fish paste, fish and clam powder etc both imported as well as those produced within the country. Regulations have also been enforced for factory layout, water supplies and sanitary conditions. The processor is required to comply with these specifications (Annexure II-G) in order that he becomes eligible to operate his plant.

Before a new plant is put into operation, the inspection authorities examine the layout and by a scoring system evaluate its soundness. It is necessary for a plant to score 80 out of 100 marks to become eligible for recognition by the Department. Likewise, the water supply of the factory and the general santitary conditions are also examined. If defects are found, the plant is given six months' notice for rectification after which period another investigation is made. If the defect is not rectified within this time, the plant is black listed and ceases to be eligible for being brought under the C.G.S.B. Scheme.

Inspection laboratories play a very important role in the working of the whole inspection system. Central laboratories established at important centres like Halifax and Vancouver fulfil a dual role viz (a) routine tests on imported and home made products and (b) regular studies on samples collected from units within the country for the purpose of advising on quality control measures. Problems of immediate importance referred to the laboratory by processing firms are investigated. If long term research investigations are involved, such problems are referred to by the laboratory to the Fishery Technological Stations, set up under the Fishery Research Board of Canada in Halifax and Vancouver respectively. Close liaison is, however, maintained between the inspection laboratories and the Research Board laboratories in conducting investigations on such problems.

The field staff collect samples of water, fish at various stages of processing and the finished products regularly, in many cases almost daily, and pass them on to the laboratories. These samples are subjected to various physical, organoleptic and bacteriological tests for checking conformity to the specifications for each product. Those that do not conform to specifications are not allowed to be released for the market and are destroyed. Those that pass the tests are permitted to be packed under the seal "Canada inspected".

In the case of wooden casks and containers for packing pickled products, the inspectors examine them before they are used for packing. Large processing plants have the services of full-time inspectors who check the incoming raw materials and the materials as they go on to the production line. The inspectors are vested with powers to hold the material at any stage if it does not satisfy the specifications. In such cases the officers draw elaborate samples for critical analysis in the laboratories whose decision forms the basis for final rejection. Provision, however, is made for appeals against the decisions of the laboratory but this is very rarely resorted to by the trade as they value and respect the decisions of the Inspection authorities.

Inspection of Imported Products. Imported products are also subjected to very thorough examination. In the case of canned fishery products, a minimum of 48 samples is drawn from each code under each type immediately on arrival of the cargo in port and passed on to the laboratories. The consignments are held in the port under the 'held' tag until satisfactory results are made known by the laboratories.

In the laboratories the samples are subjected to a 30 day incubation at 37°C before testing for sterility. This is followed by physical and organoleptic tests covering the external and internal conditions of can and lacquer, vacuum, weights and grade, freedom from foreign matter, odour, flavour and colour of contents and label requirements. The tests normally take altogether 40-45 days after which the decision is taken to release or reject the cargo.

In the case of frozen cargo a minimum of three master cases are drawn from each type and size grade for detailed bacteriological and physical examination. The samples are examined for total bacterial plate count, coliforms (total 100 per gram), staphylococci and salmonella (to be absent in 100 gram sample).

Some tolerance is allowed by convention, for short weights and other physical characteristics in the case of all these products but the defectives are in no case allowed to exceed 10 per cent in 10 per cent of the samples under test. Presence of swelled cans, manifestation of non-sterile condition, decomposition of the contents or presence of undesirable foreign matter in canned prawns and presence of pathogenic organism in frozen products are sufficient reasons for rejection of the entire lot under test, and such cargo is refused entry into Canada.

Reduced Sampling Scheme. However, the Canadian inspection authorities have introduced a'reduced sampling' scheme in order to lessen the delay of the tight inspection scheme to bonafide exporters who consistently supply quality goods. Under this scheme all suppliers whose products are found to meet specifications in five consecutive shipments are placed under reduced sampling whereby only a smaller number of samples are drawn from subsequent shipments without holding the consignments. If, however, the spot check samples show defective conditions at any later stage the exporter is removed from the reduced sampling list.

Of particular interest to India is the inspection of canned shrimp in Canada. The Indian canned shrimp consignments exported to Canada used to contain smaller number of master cartons under each code with the result that the regular sample drawn by the Canadian inspection authorities was often found to be prohibitively large. The Department could not show any relaxation to one country alone. Moreover, several shipments received in Canada from India prior to 1965 turned out to be defective from the point of view of organoleptic and bacteriological standards. Under the circumstances the Canadian Department was not prepared to show any relaxation on the method of sampling and inspection to Indian canned products. In subsequent years exports from India to this country almost stopped. However, since the introduction of Fish Inspection in India a few consignments of canned prawns were exported to this country at the instance of the CIFT. These consignments were subjected to longer incubation than was required by the Indian inspection rules, to be in line with the Canadian inspection regulations, before certifying for export. All these consignments were passed and allowed entry into Canada. The Survey team held discussions on the different aspects arising out of this situation with the officers of the Fish Inspection Department. The Department has now agreed to treat the Indian consignments on reduced sample basis, and release them on arrival under the following conditions without holding them until after the inspection results are known:

(1) The next four consignments of Indian canned shrimps will be subjected to detailed sampling as is done now in order that sufficient background data

is available to the Department of Fisheries, Canada. However, the consignments will be released immediately on arrival.

(ii) If the results of the above four consignments are satisfactory, all subsequent shipments will be released after taking only spot samples.

(iii) It must be ensured by the Inspection Agency in India that all goods exported to Canada are subjected to the same rigorous tests in a laboratory by competent personnel as are in force in Canada (which means longer incubation on a larger sample) before allowing shipment.

As a follow-up action, the Director of Inspection in Ottawa, has issued instructions (as given in Annexure III-H) to the regional laboratories regarding the change in procedure. A favourable climate has been created as a result of the efforts of the Survey Team and the disadvantages suffered by the Indian exporter regarding shipments to Canada have been removed.

USA. In the United States fishery products have not so far been brought separately under mandatory inspection. But being food items, products especially those imported from other countries, are covered by the Food, Drug and Cosmetic Act operated by the Food & Drug Administration of the USA. However, action has already been initiated to bring fishery products also under mandatory inspection, and nine bills detailed in Table B-16 are pending with the US Congress at various stages of enactment.

Table B-16

Proposed Mandatory Fish Inspection Bills Pending in 91st Congress

Adm. Agency	Level of Inspection	Full Implementation Time	Import Provision
Senate:			
S. 1092 HEW*	Continuous inspection in plant--all times plant is operating	Minimum - 2 years Maximum - 3 years	Requirements similar as promulgated for domestic industry
S. 2712 HEW	Fully continuous where needed; surveillance where continuous not needed	Maximum - 3 years Minimum - 2 years	Requirements similar as promulgated for domestic industry
House			
H.R. 1255	Substantially continuous Man in Plant Majority of time plant is operating	Minimum - 2 years	Requirements similar as promulgated for domestic industry
H.R. 3054 HEW	Substantially continuous Man in plant majority of time plant is operating	Minimum - 2 years Maximum - 3 years	Requirements similar as promulgated for domestic industry

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*Health, Education and Welfare Department, USA.

Table B-16 (Contd)

	Adm. Agency	Level of Inspection	Full Implementation Time	Import Provision
H.R. 3683 Redine	HEW	All provisions are the same as for H.R. 3054		
H.R. 7905	HEW	Continuous inspection in plant -- all times plant is operating	Minimum - 2 years	Requirements similar as promulgated for domestic industry
H.R. 5556 Pepper	USDI[+]	Spot check inspection in plant once a week	Maximum - 6 years	Substantially less than required for US industry
H.R. 11262 Keith		Spot check not defined in bill; probably once a week	Maximum - 3 years	Requirements similar to those promulgated for domestic industry
H.R. 12986 Staggers	HEW	Fully continuous where needed; surveillance continuous not needed	Maximum - 3 years Minimum - 2 years	Requirements similar as promulgated for domestic industry

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[+] US Department of Interior, Bureau of Commercial Fisheries (August 1, 1969).

Of particular significance to India, as an exporting country, are two Bills viz S 1092 and S 2712 which seek to raise the level of inspection for imported fishery products on par with the domestic industry.

The provisions in these Bills are such that when enacted all processing units in countries exporting to USA will also be subject to the same rigorous scrutiny by the F.D.A. as is envisaged for factories within the USA.

Functions of an advisory nature like formulation of regulations for factory sanitation, hygienic requirements for products, quality specifications, and process control at different stages of production are the responsibility of the Bureau of Commercial Fisheries under the Department of Interior. The Bureau has separate chemistry and microbiology laboratories in Washington, D.C. for handling these problems.

Before formulating specifications for a commodity, the laboratry examines several thousand samples from different factories handling such products. The next stage is to conduct experiments in selected factories which are likely to last for over a period of three to four months. During the entire period the study team is supposed to work in the plant. After these investigations are completed, standards are worked out for the commodity. By this process the Bureau has already formulated specifications for different commodities like fresh and frozen cod, haddock and sole fillets, breaded fish products, canned sardine, as the basis for the inspection of all these commodities in USA.

USDI (Voluntary) Inspection Scheme. The Bureau also operates a voluntary inspection scheme known as the 'USDI Inspection Scheme' (United States Department of Interior) which offers the following three kinds of services to the trade:

1) Continuous Inspection. Full time inspectors are posted in the plants where they exercise a continuous check on the preparation, processing and storage of the fishery products. This service is made available only to plants which meet rigid sanitary requirements for facilities, equipments and products. Products packed in any plant operated under the continuous inspection programme in compliance with the USDI inspection

regulations are permitted to use the official USDI inspection mark "packed under the continuous inspection of the US Department of the Interior" or by the mark 'US grade A' where grading is done.

2) Lot Inspection. A factory can request inspection of specific lots of fish or fishery products. The lots may be located in any place such as processing plants, warehouses, cold storages or terminal markets. On completion of examination of samples drawn by the Inspectors from the lot an official test report is furnished to the party.

3) Unofficial Sample Inspection. Samples selected by the applicant from a lot in his possession are examined and unofficial reports furnished. But in this case the Department does not take the responsibility on the representative nature of the samples. In all such cases of inspection, the processors bear the actual expenduture involved.

The inspection service has been found helpful in (a) determining whether the terms of the contract or the purchase order of the processor or importer have been met;

(b) supplementing the factories' own quality control programme through continuous process checks; and (c) settling claims for damages incurred in transit or storage. The scheme which was started around 1938 had very good response from the processors who gained considerable experience in maintaining quality. Many of them have reached a stage when they no longer require such service. Added to this is the high cost involved in the operation of the service. The Department is now considering ways and means for extending the service to the industry without putting the financial burden on them.

Unlike the Bureau of Commercial Fisheries, the Food & Drug Administration is a regulatory agency charged with the enforcement of the Federal Food, Drug and Cosmetic Act, and functions under the US Department of Health, Education and Welfare. The Department has district offices in important ports served by full fledged laboratories for conducting various tests as envisaged in the different regulations passed under the above Act.

Fish and shell fish products of different type like fresh, chilled, frozen, canned, cured, breaded, etc are now covered by the above Act and various regulations relating to these have been passed. Very recently (in September, 1969 one more Act, Public Law 89-755, known as 'Fair Packaging and Labelling Act' has come into effect.

4) Sampling Method. Generally 5 per cent of the total shipments of items covered by the Meat, Food & Cosmetic Act are sampled annually. The sample size varies with the commodity, being more in the case of food items which have a higher deterioration potential like fishery products. In this case samples are drawn in such a way that a minimum of three are taken from each size grade and type represented in the lot. These samples are examined for all characteristics and possible additives in FDA laboratories before allowing the consignments to be released. If in the course of such tests a product from a particular party is found defective all subsequent shipments from that party will be subjected to detailed sampling and tests. The Administration feels that coverage of 5 per cent of the shipments is too small but they cannot increase it at present due to want of personnel to do the job. They are also aware of the fact that some bad merchandise may get entry into the country as a result of this but expect that this will be taken care of when the proposed Bills are enacted.

While discussing these points a reference was made to the provision in the regulations regarding canned shrimp which stipulates that the solid content shall be 64 per cent of the water capacity of the can. It was pointed out to the officers that this puts a severe strain on the Indian canned shrimp exporters who use only one type of can at present viz 301 x 206 which requires a fill of 142 gms to satisfy the 64 per cent fill rule. Competitors in the US market have the advantage of different types of cans (307 x 113) which require only a fill of 128 gms to satisfy the above rule. The prices obtained by both India and its competitors are the same. The Indian producer thus has to put extra weight to the extent of 14 gms for every can to satisfy the US regulations. It was also pointed out to them that the Codex Committee for international standards for fishery products has recognised a solid fill of 60 per cent for canned shrimp in brine. The officers appreciated the force of the argument and expressed the hope that the recommendations of the Codex Committee are likely to be accepted by the US Government also but suggested that the Indian packers be advised to fulfil the current regulation until such time as the changes are accepted. According to the present set up if any consignment within the 5 per cent sampling happens to fall short of the regulations, the consignment has either to be withdrawn or superscribed 'substandard fill', if it is to be accepted for entry into United States.

Another problem that was discussed with FDA was the permissibility of the use of sodium and potassium polyphosphates as dip or covering medium for frozen fishery products as an aid to prevent drip loss. The officials informed that the US processors also had made a similar request to the FDA for inclusion of the chemicals among permissible additives and that the matter was under active consideration. The officers sought the technical advice of the Survey Team on the problem and the results of the investigations carried out in India over the past three years were made known to them. It was pointed out to them that the maximum absorption of phosphate was only to the extent of 300 mg per cent of shrimp, and that the flavour and appearance had substantially improved. The FDA has taken note of these findings and informed that in all probability permission will be given for the use of this chemical soon.

It was pointed out in this connection that India had already a preshipment inspection system with prospects of introducing complete bacteriological standards for all fishery commodities. It was also mentioned that within the next one year or so it was contemplated to enforce sanitary regulations in all units engaged in the handling of fishery products for export. The FDA officers were very much satisfied with the steps being taken by India and stated that under such circumstances, it should be possible for the US Government to recognise the certificates issued by the Indian authorities and thus exempt the Indian **units** from the purview of the Bills when they come into force.

Denmark. In Denmark a Quality Control Division of the Ministry of Fisheries is responsible for testing and approving all imported fishery products under the Fisheries Act (Quality Control on Fish and Fish Products), No. 167 of May 12, 1965. All regulations made in pursuance of this Act concerning the sorting, packing, marketing, wrapping, storing and quality of fish and fish products, shall be applicable also to foreign merchandise imported into Denmark, unless merchandise is carried through the country in transit only.

The Minister of Fisheries nominates a Quality Committee consisting of six representatives of the industry, one representative of the health authorities, and one representative of the Ministry of Fisheries. The representatives of the industry are appointed in accordance with the proposals made by the concerned industrial organisations.

Spain. In Spain the control enforced in 1966 relates to the labelling which should include (i) country of origin; (ii) common name of the canned products; (iii) preparation of the canned product; (iv) various ingredients contained in the preservatives; (v) any additional ingredients, like colouring material, etc; (vi) minimum weight in metric system; and (vii) instructions on the use of preparation.

Netherlands. In Netherlands, the quality control is exercised by the Commodity Board established by the Act of May 24, 1956 with regard to (i) quality standards (marketability and/or fitness for human consumption) in connection with landings and sales of fish for human consumption; (ii) quality standards for shrimp and mussels; (iii) stimulation of the care and the quality of fishery products; and (iv) issue of quality prescriptions in the case of exports.

Norway. In Norway the quality control is enforced under the Act of May 28, 1959 on Quality Control of Fish and Fish Products. For the purpose of this Act, fish and fish products include fish, herrings, shell fish and molluscs with by-products and other products. The provisions of this Act apply also to fish and fish products of foreign origin. In order to ensure that the fish and fish products to be sold internally or exported are handled in the best possible manner to satisfy the necessary quality standards, regulations may be framed on the following points:

i) Handling, processing, storing, and transport of fish and fish products, including the equipment, such as, fishing vessels and means of transport used in the catching and transport of fish and fish products and buildings and plants used for processing, storing and sale of fish and fish products;

ii) Prohibition of the use of certain varieties or sizes of fish or products at all times or in certain periods or from certain fishing grounds;

iii) Regulation on the sale of fish and fish products to the processor in order to prevent quality deterioration due to delays in processing;

iv) Standards governing quality, grading, assortment, product designation, packing, marking and weight content;

v) Inspection of fish and fish product, including prohibition of import sale and export of fish and fish products, which have not been inspected;

vi) Requirements with regard to the professional qualifications of technical managers of fish processing plants.

Inspection under this Act shall be under the authority of the Director of Fisheries.

Korea. In Korea, there is a very strict and efficient inspection procedure laid down by the Government of Korea for the processing and exports of marine products. Each processing plant is given a licence by the Ministry of Agriculture & Forestry and it has to comply with fisheries' laws and inspection standards.

The Ministry of Health and Social Welfare enforces the provisions of the Food Sanitary Laws for inspection of sanitary conditions of the premises of the factories and processing plants. The main conditions laid down under this inspection standard for freezing and cold storage of the marine products are:

i) The temperature of the freezing room shall be kept at -25°C prior to freezing of the product;

ii) The time required to freeze a product on 5°C thick to -10°C shall not exceed five hours and the product shall be frozen to -15°C of centre temperature of the product, otherwise the product shall not be taken out from the freezing room;

iii) A frozen product taken out from the freezing room shall be glazed and packed with water proof materials and should be stored under -15°C. The tolerance for cold storage temperature shall not exceed + or -3°C.

iv) The movement of the product from the storage shall be performed under the supervision of the inspectors and the temperature shall be kept at -13°C during the movement.

v) De-frosted product shall not be taken for freezing again.

The quality standards prescribed for shrimp relate to the shape, colour, odour, free ammonia, selection of foreign matter, glazing and temperature. The same factors are applied to other shell fish and mackerels. For instance, for packaging and labelling, especially tuna and mackerel, the kind of containers and the material used along with each type of packing has been prescribed. With regard to labelling the name of the product, net weight (and/or pieces) and the name of the country of origin shall be stated on the unit package. On the master package, the type of the product should also be mentioned besides the above items. In relation to frozen shrimp, pieces of shrimp and count per pound shall also be indicated.

The inspection methods relate to both production processes and inspection in the plant and final inspection for export. The inplant inspection is for examination of the freshness of raw material preparation, freezing and cold-storage conditions. Inspector would record the temperature of freezing and cold storage, without which final inspection will not be undertaken.

The final inspection shall be done within four months after the date of freezing the product. The organoleptic inspection shall be performed with regard to less than 3-unit package sample at random from each processing lot.

United Kingdom. There is no separate fish inspection authority in UK. This function is shared by the White Fish Authority which gives technical assistance to the processing industry and the health authorities in cities and countries whose inspectors choose the wholesomeness of fish sold in markets. The Corporation of London has accepted the following standards for cooked peeled and uncooked shell-on prawns:

Faecal coli:	Should be less than 10 per gramme in 80 per cent of samples and always less than 100 per gramme in all samples.

Staphylococcus aureus:	Should be absent from 1 gramme in all cases.
Salmonella:	Should be absent from 50 gramme in all cases.
Total plate count:	Should be less than 2,50,000 in 80 per cent of samples and less than 2,000,000 in all samples.

Results better than these standards are regarded as satisfactory. Failure on more than one standard should be regarded as warranting condemnation as being unfit for human consumption. Failure to satisfy any one standard would require consideration as to the degree of failure in any condemnation.

Japan. In Japan fish products inspection is carried out under the authority of the Japanese Frozen Food Inspection Corporation. This Corporation has formulated specifications for various fishery commodities for export and organises inspection of both exported and imported products for compliance. Details of standards adopted for frozen shrimp are given in Annexure II-I. These standards also envisage that:

i) Temperature inside the shrimp should be less than minus 10°C.

ii) Net weight must be the indicated weight.

iii) Packaging material should be sanitary, should be strong enough to prevent damage to the contents.

iv) Labels should reliably describe the contents.

v) Foreign substances should not adhere to or be contained in the shrimp.

vi) Contents must not be tainted. The volatile basic nitrogen content should be less than 30 mg per 100 gms of frozen shrimp.

vii) The bacteria count should be less than 100,000 per 1 gramme of frozen shrimp.

viii) Colitis bacteria should be negative per 100 gms of frozen shrimp.

ix) Size should conform to the size indicated or as contracted.

It is also stipulated that when an average grade for the above 9 points is 30 per cent or more, frozen shrimp in shell will be passed.

Maintenance of Quality Indian processing sector is gradually establishing its reputation in the overseas markets. However, the rejection of a few consignments at the buyers end on grounds of quality affect not only the few responsible for it but the industry as a whole including those who are extremely quality conscious. If proper care is not taken continously and at all stages of handling the product, it will be extremely difficult to maintain the quality. In the present structure of the industry, where many small exporters without adequate processing facilities have entered the field, the problem of quality maintenance has become all the more difficult. Due to very keen competition for raw material, the smaller units have to be content with whatever raw material is available in the market. Prompted by quick profit motive some of these new entrants also buy and mix up substandard and damaged raw material before processing.

The present rules provide only for inspection of the end product prior to shipment and do not exercise any control over the processing units. No grading for quality is carried out except certifying conformity to minimum specifications. Such a system has the disadvantage of causing heavy losses to the producer by way of rejection at the stage of end product inspection. The amount of substandard material rejected during four years of operation of the preshipment inspection scheme (1965-68) in frozen and canned shrimps and frozen froglegs, as given in Table B-17, bears ample testimony to this.

It can be seen that the quantity thus rejected has increased from 0.9 per cent in 1965-66 for frozen shrimps to 2.2 per cent in 1967-68. In canned shrimps the increase has been from 1.09 per cent to almost 2 per cent in 1968-69.

Table B-17

Quantities Rejected at the Freshipment Inspection Stage During 1965-1968 16/

Qty: Kgs.

Year	Frozen Shrimp		Canned Shrimp		Frozen Froglegs	
	Quantity Inspected	Quantity Rejected	Quantity Inspected	Quantity Rejected	Quantity Inspected	Quantity Rejected
1965-66	69,77,282	65,903(0.9%)	9,23,626	10,097(1.07%)	23,331	204(0.8%)
1966-67	9,92,99,927	1,24,087(1.2%)	17,16,202	42,827(1.2%)	7,36,165	6,567(0.89%)
1967-68	1,16,85,964	2,58,584(2.2%)	17,59,936	28,302(1.0%)	6,19,722	1,172(0.02%)
1968-69 (Upto Sept.'68)	66,93,312	85,570(1.3%)	10,68,053	20,271(1.9%)	1,03,304	175(0.17%)

16/ : Source: Central Institute of Fisheries Technology, Ernakulam-6.

Part of this increase may be due to the expansion and improvement in the quality control activities themselves; but a part is also due to the growing size of exports, raw material inadequacy and the entry of large number of small units with quick profit motive in the industry.

The quality of raw materials and hygienic and sanitary conditions under which the materials are brought, peeled, graded and processed can be considerably improved if quality control inspection is carried out also in the processing factory and especially in the peeling sheds where bulk of the raw materials is handled. It is at the contracted private sheds and in the smaller factories where hygienic and sanitary conditions are to be watched. Regular inspection of raw material of the receiving and grading sectors followed by inspection of the processing plants is perhaps the only means to help maintain the quality of the product at a high level.

A survey of the industry has shown that the freezing or canning units can be grouped in three categories on the basis of their performance on quality and in-plant control:

i) Those firms where the defective, decomposed and damaged pieces, are removed at various stages of processing and where strict cleaning schedules are practised so that the final product shows better average quality with regard to organoleptic and bacteriological tests. Only 15 per cent of the firms fall under this category.

ii) Those firms where the quality of the starting material is maintained throughout the processing stage. About 50 per cent of the factories belong to these categories. These units follow standard cleaning schedules but not sufficient enough to prevent possible external contamination.

iii) Those firms where the end products show much higher bacterial loads than in the initial raw material. No special care is taken to remove defective pieces from the raw material or to maintain strict hygiene in the processing unit. Such conditions invariably are met in plants where processing and storage space are leased out and where the responsibility for maintenance of hygiene is not fixed.

Such wide disparity in the performance is not entirely due to lack of care or inplant control but also due to variations in the initial quality of raw materials handled by each. Of course inplant quality control is not excercised in most of the plants. Only four of them have their own facilities to a limited extent for testing of chlorine levels in water or seam testing of cans. A large number of units also lack qualified technicians to man the operations on sound technical lines. This clearly points to the need for a far more effective system of quality control on the various fishery products processed for export. Such a system must exercise control over fishing vessels, primary processing centres, transport vehicles, ice plants and processing factories. All these units should be brought under a licensing system for effective enforcement of the regulations.

Bacteriological Quality of Indian Frozen Products From the bacteriological point of view the Indian frozen products (fresh & frozen) have been showing mixed results. Bacterial contamination of the product can happen in a variety of ways during the various stages of processing. The numerous organisms present in the skin, gills and guts find slow entry into the flesh after death. Equally dangerous is the possibility of external contamination. This can happen from unclean surfaces with which the material comes into contact during transportation and in the processing plant, from water and ice used in processing, from the workers' hands and clothings. In many cases, the loading centres are far away from the factories with the result that the raw materials have to be transported over long distances. These distances are covered by trucks followed by overnight journey by train or exclusively by train with re-icing at intermediate transhipment points or by coastal liners. If proper care is not taken during such long trips there is always the possibility of the material undergoing rapid spoilage. In the processing plant the bacterial load may undergo several changes. During the interval between arrival of the raw material in the factory and the final processing there will be slow multiplication of the residual bacteria besides further contamination from external sources. Thus, under the existing set up of the shrimp freezing industry there is every chance of appreciable bacterial build up in the raw material before it is frozen. Extensive surveys made in the past on the bacteriological characteristics of commercially frozen shrimp in India clearly established this fact as indicated in Table B-18.

Table B-18

Percentage of Samples Falling Into Different 17/ Ranges of Bacterial Count According to Type of Frozen Products

Total number of samples
examined = 981

Range of bacterial count	Head-less	Konch	P & D upto 70/lb	P & D above 70/lb	CPD	CP
1×10^3	0.2	nil	nil	nil	0.8	nil
$1 \times 10^3 - 1 \times 10^4$	4.8	2.0	0.5	0.9	10.1	3.2
$1 \times 10^4 - 1 \times 10^5$	44.8	25.6	16.8	6.6	31.6	11.2
$1 \times 10^5 - 1 \times 10^6$	41.1	49.8	64.9	56.6	35.3	51.0
$1 \times 10^6 - 1 \times 10^7$	8.9	21.0	16.6	34.6	20.2	31.4
$1 \times 10^7 - 1 \times 10^8$	0.5	1.6	1.2	1.3	2.0	3.2

More or less the same trend is often found on examination of the Indian products by laboratories in the importing countries. The data relating to three Indian consignments received by one of the importing firms are given in Table B-19.

17/ Central Institute of Fisheries Technology, Ernakulam.

Table B-19

Bacteriological Analysis of Peeled & Deveined Frozen Shrimp in India

Factory-1, Cochin

Sample	Standard Plate Count Per Gramme	Caliform per gramme	Coagulace Pos. Staphococci (Dil. Level)
36-40	109,000	0.0	100% neg
36-40	340,000	0.0	100% neg
36-40	104,000	0.0	100% neg
36-40	560,000	0.0	100% neg
41-50	99,000	0.0	100% neg
41-50	78,000	0.0	pos @ 0.01 ml
41-50	74,000	10.0	pos @ 0.01 ml
41-50	540,000	30.0	100% neg
51-60	720,000	10.0	pos @ 0.01 ml
51-60	790,000	30.0	100% neg
51-60	620,000	10.0	100% neg
51-60	320,000	0.0	100% neg
Average	363,000	7.5	25% pos @ 0.01 ml.

Factory - 2, Bombay

Sample	Standard plate count per kg.	Caliform per gramme	Coagulase positive staphylococci
36-40	1,310,000	nil	0.1
36-40	747,000	nil	0.1
41-50	410,000	9.1	0.0
51-60	1,610,000	7.3	0.1
51-60	550,000	0.0	0.01
61-70	1,750,000	0.0	0.01
61-70	710,000	2.6	0.01

Factory - 3, Cochin

Sample	Total Plate Count	MPN Total Caliform	Coagulase Positive Staphylococci
(16-20)	17,000,000	23	100% neg at all dil.
(16-20)	21,000,000	460	"
(16-20)	11,000,000	150	"
(21-25)	8,900,000	23	"
(21-25)	8,200,000	1,100	"
(21-25)	43,000,000	1,100	"
(26-30)	6,400,000	23	"
(26-30)	22,000,000	23	"
(26-30)	40,000,000	1,100	"
(31-35)	28,000,000	43	"
(31-35)	19,000,000	43	"
(31-35)	22,000,000	1,100	"
(41-50)	28,000,000	1,100	"
(41-50)	23,000,000	1,100	"
(41-50)	43,000,000	1,100	"
(51-65)	7,300,000	240	"
(51-65)	6,100,000	460	"
(51-65)	28,000,000	1,100	"
Average:	18,100,000	572	100% neg at all dil.

Note. This product appears to be acceptable by organoleptic standards of evaluations. However, microbiological analysis shows it to be unacceptable for use in our breading plant. The total plate count average is at least six times higher than anything we normally accept. The coliform is also above our standards. The coliform indicates the shrimp were either caught in polluted water or processed in a very insanitary plant.

The results reported at three also indicate the wide varieties in the bacterilogical quality within samples. This normally reflects on the lack of control at the production end.

Although wide variations are seen in the results from the first two factories their products are acceptable while the products from the third factory are totally unacceptable.

A peculiar odour, ascribed to bacterial spoilage, has also been noticed in the case of Indian frozen shrimp products both by the importers and the Food & Drug Laboratories. The laboratory which carried out extensive investigations on this problem feels that the smell is due to bacterial contamination caused by the use of unclean water at some stage of processing of the product. Although the material (prawn) after thawing looks good there is an offensive smell immediately on opening the cartons both on the cartons and on the surface of the blocks.

Compulsory In-plant Inspection

In view of the keen international competition in the seafood trade and the need to maintain high quality of the products, it is essential that India should introduce quality control at all stages in the production and processing of fish and fishery products and soon introduce strict hygienic standards in all units of production. With high standards of quality, it would be possible to project a good image and get exemption from the mandatory inspection by the inspection agencies in importing countries. While introducing quality control, it is also important to see that the production units and processing plants are given advice to bring any change in structure or methods and on time for making the improvements to satisfy the requirements. The following steps may be taken at a very early stage. In this connection, it will be useful to note the legislative action proposed to be taken by some of the countries like USA.

(i) All peeling sheds engaged in pre-process preparations shall be licensed. In order that a peeling shed may become eligible for obtaining a licence, it shall satisfy certain minimum requirements in respect of design, water supply and sanitation. Existing peeling sheds which desire to apply for licence shall be given a grace period of six months for complying with the requirements.

(ii) Processing factories should also be required to satisfy minimum requirements in respect of sanitation, processing facilities, machinery, water and ice supplies. Processors/exporters who do not possess such facilities at present shall be given six months to one year's grace period for compliance,

(iii) All fishing boats engaged in supply of raw material for processing shall be required to carry ice and preserve their catch properly and maintain strict sanitary conditions.

(iv) Inspection authorities shall maintain periodic records to show whether all the above units and establishments comply with the regulations. They shall be vested with power to delicense units which fail to satisfy the provision of the regulations. It is also necessary to introduce a system of continuous in-plant inspection in all units engaged in processing of fishery products for export, the expenses for which service will have to be met by the units themselves. Basis for continuous inspection is provided in Annexure II-J .

(v) Statutory permission should be given for the use of harmless chemicals like sodium tripolyphosphate and potassium dihydrogen phosphate as glazes in the preparation of frozen shrimps. These chemicals have proved efficient in completely preventing thaw drip loss in frozen shrimp. By legalizing their use, the country can save nearly 700 tonnes of shrimp alone based on the present level of export. A similar chemical under the trade name 'calgon' is currently being used in some of the shrimp and fish processing factories in USA and Canada. The Survey Team's discussions with the Food & Drug Administration officials covered official acceptance of such chemicals. The two chemicals are manufactured within the country and can be made available in succifient quantities to meet the demand of the industry.

(vi) All fishery products exported from India including dried prawn pulp, lobstertails and other commodities should be immediately brought under pre-shipment inspection. Bacteriological standards, wherever necessary, should also be introduced without delay.

However, prior to their introducing the Inspection and research agencies should closely work to bring to the notice of the industry, the steps to be taken to maintain the quality at various stages.

(vii) The Survey has clearly brought out that the fish inspection service as it exists today has not been able to create and sustain the proper image of the Indian product in foreign markets. There is need for reorganisation in such a way that the possibility of substandard grade getting into the consignments at the time of shipment is completely prevented. The Inspection Organisation should be supplemented by full-fledged laboratories at important centres like Cochin, Bombay, Madras and Calcutta to handle all technological problems facing the processing units from time to time. All the testing laboratories established at different inspection centres should take guidance from the central laboratory. While the testing units or sub-centres handle routine physical, chemical and bacteriological examinations of export commodities, the Central Laboratory should function as an Appellate Laboratory for final decisions and should deal with problems connected with unit sanitation, formulation of specifications for different commodities, evolving methods of tests and sampling and on problems of process control. However, when the problems do not have a direct bearing on the day to day unit performance and require long-term investigations they should be referred to Research Laboratories like the Central Institute of Fisheries Technology. The central laboratory can be organised with three sections, one for studying problems of frozen and canned marine products, one for dried and salted fish, and the third for applied bacteriology problems under senior scientific officers assisted by analytical chemists.

2.4 Problems of Frozen, Canned and Dried Fishery Products

A. Frozen Products

Imbalanced Growth. In regard to frozen shrimp products, it is time that the entire set up of expansion is fully reviewed. As has been explained elsewhere Cochin-Alleppey area seems to have been over-crowded, about 85 per cent of the total processing capacity of the country having concentrated in this region alone. For proper balancing of expansion programmes in the coming years, it is suggested that the entire coast line be divided into the following sectors viz., (i) Gujarat (ii) Maharashtra & Goa

(iii) Mangalore including Malpe in Mysore State (iv) Cochin including Calicut and Trivandrum in Kerala (v) Tuticorin including Cape Comorin in Tamil Nadu (vi) Madras area (vii) Orissa (viii) Andhra Pradesh and (ix) West Bengal. Maharashtra area is already showing a static position and has 80 per cent unutilised capacity. The Gujarat coast remains untapped even in spite of the fairly high catches of shrimp from that area. Mangalore is the only area on the west coast where the number of processing units/exporters has registered an increase between 1968 and 1969 although this area also has an unutilised capacity of over 60 per cent. On the other hand, the growth of processing units or exporters on the east coast has been very slow and the entire coast line remains less exploited as compared to the west coast. The few plants put up in this area too show a large unutilised capacity. This is mainly due to the movement of a large portion of raw material to Kerala.

Regulation of Processing Capacity. Due to the seasonal nature of the fishery, it is inevitable that the plants always have an excess capacity with a view to achieving the maximum utilisation during seasons of heavy catch when the raw material prices usually come down. It will be a safe policy, therefore, to allow expansion of processing units in each of the sectors mentioned above to take care of the seasonal peak in the supply of raw materials in respective sectors leaving an average utilization of about 50 per cent on the whole. On this basis no further expansion in the number of freezing units is called for at present either in the Cochin-Alleppey or Maharashtra sectors unless additional efforts are made to introduce large shrimp trawlers for increasing the volume of catch. Pending this, establishment of new units in these sectors will only add to the already existing competition and to the large unutilized capacity. For a balanced development, however licences should be issued to parties who wish to establish processing units in areas like Gujarat and east coast sectors where there is considerable scope. It is also necessary to keep a watch on the raw material supply position in each sector with particular reference to all varieties of fish and shell fish which could be processed on a large scale.

Improvements in Freezing and Packing. It has been observed during the overseas survey that the method of packing and freezing followed in India needs improvement and should undergo radical changes if better unit value is to be realised for Indian frozen shrimp in export markets. Block frozen shrimp is thawed by the processors in the US and reprocessed into marketable commodities like breaded prawn or I.Q.F. products. The very sizes of block frozen prawns are also thawed out and converted into sausages and other consumer products. These reprocessed materials are sold to consumers at a high price than the one realized by the Indian exporters. Another important observation made during the overseas survey is that these products when reprocessed from P.D. frozen prawns of counts upto 61-70 pound are regraded one step high (the grade of headless from which the P & D has been produced) whereby the processor in US stands to gain a higher price which does not pass on to the Indian exporters who pack and export the goods as a lower grade.

Under these circumstances, it is necessary that all encouragement is given to the existing freezing units irrespective of the areas of their location to import necessary machinery for preparation of individually quick frozen shrimp. Even bulk packing of I.Q.F. products will mean an average gain of 15 cents per pound to the exporter and a corresponding increase in the foreign exchange earnings to the Government. The Indian producer will also be able to cut down the cost of production as he will not be required to use waxed cartons for I.Q.F. bulk packing. This saving on waxed cartons (approximately Rs 5 per master carton) would compensate to some extent the slight increases in freight rate (usually master carton holds 50 lbs in I.Q.F. form) and processing cost. The present rules regarding eligibility for import against export performance should also be suitably amended to enable the processor to obtain machinery required for preparation of I.Q.F. shrimp.

Inspection rules will also have to be properly amended to allow the Indian producers to grade P & D prawn of sizes upto 61 - 70 lb., butterfly and fantail packs to be graded according to the headless count from which these are prepared.

Another important observation made by the Survey Team is the non-uniformity of the pieces in the consignments exported from India. This particularly affects restaurants, chain stores and such other establishments which represent a large section of consumers of frozen shrimp products. The processors and importers in USA and Canada feel that this non-uniformity is due to the errors brought in by manual grading usually followed in India. Maintenance of uniformity in the pieces contained in a carton or block will definitely help in raising the price of Indian shrimps. In order to achieve this the Indian producers should start using mechanical grading equipments as early as possible. This item therefore also be included in equipment that should be allowed to import from abroad. Easy credit facilities on liberal terms should be allowed through banks or directly from Government for introducing these essential steps of modernisation in the freezing sector of the industry. Alternatively government might promote joint ventures with foreign firms to license these facilities. At the same time, efforts should be made to manufacture these items in the country in collaboration with foreign firms which are already manufacturing these items and specialised equipment.

Frozen Storage Facilities at Ports. It has already been mentioned that the inadequate facilities at the shipping points and the long delay at the wharfs for completing customs and port formalities affect the frozen cargo very much resulting in meltage and consequent lowering in quality. As a highly perishable item this product, therefore, must get preferential treatment. The port authorities or government should directly come to the assistance of the processing industry by providing frozen storage facilities within the port area of every shipping centre. It is estimated that a 500 tonne storage plant would cost approximately Rs 0.8 million including land, building, equipment and installations. A reasonable charge can be realised from processors for storing the cargo. This warehouse is to be a bonded warehouse to be commissioned by the port authority. It is suggested that pre-shipment inspection is done at this point so that the goods after inspection can be held under government custody till these are loaded in the vessel. Customs inspection can be conveniently carried out sufficiently in advance before the goods are actually shipped, so that last minute delays and consequent spoilage can be prevented. It has also to be emphasised that leaving the inspected goods in the hands of the processors sometimes leads to malpractices which affect the image of the Indian product in the overseas countries.

Transport of Frozen Products. Another important factor that has to be considered for all future development programmes is the provision of refrigerated vehicles for transport of raw material and finished frozen cargo. As most of the importing countries are introducing strict sanitary regulations for imported fishery products it will become absolutely essential for India to take maximum care in the preservation and transport of raw materials. Insulated trucks and open trucks are used by most of the processors. But these have their own limitations and involve additional cost on ice. By using refrigerated transport not only can the processors save on ice but also reduce wastage on account of spoilage. Each truck with 'Thermo King' refrigeration unit is estimated to cost a little over Rs 100,000 Processors may be permitted to import necessary machineries for construction of refrigerated trucks. The more modern unit using polar stream refrigeration manufactured by M/s Union Carbide of USA has been found more efficient and useful than Thermo King units. A small unit suitable for trucks is estimated to cost only $ 2,500. However, operation of such units will become possible only if liquid nitrogen becomes easily available within the country. Railway wagons may be imported for the purpose of carrying out feasibility studies in collaboration with the Central Institute of Fisheries Technology. The scope of issuing nitrogen for use in insulated vans for transport of frozen cargo should be introduced immediately. The liquid nitrogen is at present available in Cochin, Madras and Bombay.

B. Canned Products

Non-Availability of Cans of Right Sizes. One of the major problems faced by the canning sector relates to the non-availability of cans required in the international markets. Although Indian made shrimp can of 301 x 206 dimensions (with 5 oz. prawn in brine) is acceptable in world markets, the most popular international size used for packing shrimp is 307 x 109 (with 4½ oz. prawn in brine). This 4½ oz. can is not yet locally manufactured and the processors have no choice but to pack excess weight to the extent of ½ oz. to satisfy the requirements of the drained weight imposed by the importing countries. While all the countries exporting to USA have the advantage of the right size of cans for packing 4½ oz. weight, exporters from India continue to suffer from the disadvantage of packing excess weight without realising extra compensation. This type of packing causes a loss of Rs 22.00 on every 100 cans, which in terms of foreign exchange amount to $ 7.00 per 100 cans.

A three-piece rectangular can (402 x 207 x 102) with top soldered and bottom sealed, used by the Portuguese for exporting sardine has become popular in the international markets. Non-availability of this type of can from Indian fabricators has, according to some exporters of canned marine products, proved to be the major bottleneck. The Survey revealed that Norway has recently introduced an aluminium can with ring pull ends, which is more amenable to easy opening and, therefore, likely to capture consumer acceptance. If the fabricators do not consider it economical at this stage to invest on special equipment that might be required to undertake the manufacture of such cans, the exporters of canned marine products in India might be allowed to import these cans from abroad to facilitate test marketing of the products.

High Cost of Cans. The cost of production of canned marine products in India is relatively high on account of high cost of can. The cost structure of can manufactured in India has to be carefully studied including the landed cost of tin since the economy of scale would prevent the entry of a new firm in this line. It may be necessary to evaluate the cost of making available cans of international size to the processors in India. This may necessitate subsidising the processor for compensating him for the high cost of cans manufactured in India or to permit imports. Another alternative can be to make available to the fabricators the requirement of tin at international price so as to bring down the cost.

For canning sardines, for instance, which are available in abundance on the west coast of India, considerable difficulties are experienced regarding the size and type of cans. At present packing is done in round AI tall cans and in flat quarter dingley cans exclusively for domestic market. The type of three piece rectangular can (402 x 207 x 102) with the top soldered and bottom seamed, developed by Portugal in the international market has been attempted by the Indian fabricators on a trial basis. But the price quoted for this can, at Rs 440 for 1000 cans is quite high as compared to the quarter dingley can available at Rs 296 per thousand. The cost could be considerably reduced once production on a commercial scale is undertaken. If the estimated price is made known to the canners based on a sizable turnover, they could analyse ultimate cost of processing of canned sardines and place definite orders. If, however, the investment on the special equipment is found to be uneconomic at present, Indian exporters may be permitted to import these cans from abroad. It may be of interest to note that the three piece can is gradually becoming out of date and the present trend is for aluminium cans with a 'ring pull' for sardines. These may be allowed to be imported till they can be locally manufactured on a commercial scale.

Standards. There have been several complaints from overseas buyers about packing and packaging of seafood products. These are mainly due to the absence of prescribed standards for the packing and packaging material. In view of the specific requirements of major importing countries and the keen competiton in the international market, standards should be laid down for packing and packaging material like card board cartons, waxed cartons, cans and labels used by the exporters and incorporated in the quality control and inspection measures in force in the country. The fabricators should be required to guarantee conformity of packages and materials to such prescribed standards.

Tinplate. Dependence of canning sector of the marine products industry on imported tinplate will have to continue till such time requisite improvements are brought about in the quality of indigenous steel plate, particularly in respect of phosphorus and silicon contents, the safe limit for phosphorus in the base steel used for tinplate for Open Top Sanitary (OTS) cans being 0.020 per cent. It is also necessary to remove defects such as gauge variations, cut-of-squareness, presence of greases on the surface and pin-holes.

Card Board. The quality of the indigenous duplex board used for making cartons needs to be improved particularly in respect of whiteness, calipre and scuff resistance.

Corrugated Paper Board. Most of the importing countries insist that outer cases made of corrugated paper board should have a minimum bursting strength of 200 lb. per sq. inch or more depending on the weight of the package and handling conditions. The quality of a three-ply box made of imported kraft liner which is restricted to a substance of 180 gms. per sq. metre does not, however, give the 200 lb. bursting strength, with the result that five-ply box is fabricated to achieve the necessary bursting strength, resulting in uneconomic costs. Thus the provision of import of kraft liner has become self-defeating in its purpose. The Survey, therefore, recommends that import of kraft liners of a substance of 225 gms. per sq. metre and more should be facilitated.

Labels. Though the quality of Indian labels has improved over the years, there is scope for further improvements in the quality of indigenous art paper so as to be amenable for higher quality printing. The present policy which permits import of labels, should be continued as most of the foreign buyers insist on the use of their own labels. It is rather anomalous, however, that while labels are allowed to be imported, import of art paper is not permitted. It is recommended that the Government should allow the import of art paper and institute a proper organisational machinery to ensure that the imported art paper under this scheme is used only for bonafide purposes.

C. Dried Fishery Products

One of the major problems facing the dried and salted fish industry is the decline in demand for such products in the already existing markets. Added to this is the rising costs of raw material and production. The importing countries on the other hand, often complain of sub-standard quality and of gross differences in quality between the pre-shipment samples and the actual consignments. Ceylon, which is one of the principal importers of India's salted and dried fish products used to enforce drastic cuts in the prices for non-compliance of quality specifications. However, the extent of such cuts has come down considerably with the introduction of pre-shipment inspection on dried fish exports to that country.

Many factors appear to contribute to this unfavourable position regarding this industry. Exporters who are generally not producers buy the products from small producers from various parts of the country and repack them for exports. Sometimes the products pass through an intermediary - a wholesaler in a region - before they reach the exporter. All this means, additional cost on packing at each stage and on transport.

Maintenance of Quality. On the problems of maintenance of quality, it is very difficult if not impossible to have uniformity so long as production is being undertaken on small scale. Sufficient supply of water and facilities for carrying out the salting and drying processes in a hygienic manner and proper drainage facilities are not available under the existing conditions.

Packaging and Storage. Poor packaging and improper storage are two other factors which affect the reputation of the products in foreign markets. Packing is done in gunny bags or palmyrah leaf mats. Since these are not strong enough to hold the cargo handling during transit packaging causes a good amount of breakage. No proper storage facilities are available either at the production centres or the wholesale markets of export centres, which could preserve the cargo from deterioration till shipment. It is therefore recommended that packing should be done in wooden boxes lined in the inside with polythene instead of the traditional gunny bags or palymrah leaf mats which would mean, of course, an additional expenditure of about Rs 3 for every 5 kgs. Storage facilities should also be provided at important trade centres and export points like Tuticorin and Bombay. The warehouses should be large enough to hold shipment cargo of all the exporters in the respective regions. This will facilitate holding of the cargo at low temperature thereby preventing spoilage and deterioration in quality between packing and shipments.

Proper warehousing at shipping centres and wholesale trade centres is still more important as in this particular trade the exporters are very often compelled to keep the stock for long periods before shipment. By proper storage general complaints from importing countries regarding differences in quality between pre-shipment samples and actual shipments can be avoided. It is further recommended that preservative chemicals like sodium propionate or propionic acid, which have been found useful by CIFT in preventing "red attack" in salted fishery products should be made available to the actual producers to the extent of 2 per cent of the finished weight of their production for export. Since these chemicals are not manufactured in India, import licences will require to be issued to the producers. However, it may be made a condition that in order to become eligible for such licences the producer should be required to satisfy certain minimum regulations regarding sanitation and processing facilities in the units maintained by them. As the industry has not yet developed on a sound economic footing warehousing and storage facilities at all important centres as mentioned earlier will have to be provided by the government.

It is very necessary for the Indian dried fish trade also to introduce improved techniques of production, packing and storage in the dried and salted fish industry. In the place of production on cottage industry scale large fish curing yards with modern amenities should be provided in important fishing centres. Such yards should have separate pre-process handling facilities with arrangements for salting and mechanical drying. They should also be provided with sufficiently large storages maintained at controlled humidity and low temperature within the region of 8°C. Sufficient supply of potable water and adequate facilities for drainage and disposal of waste should also be provided.

Processing and Export of Bombay Duck. In the case of Bombay duck which is one of the highly priced commodities and for which a growing market is developing in UK, France and Canada, there is urgent need for introducing mechanisation. The traditional method of drying over a period of two to three days often results in deterioration of quality, infestation by mice and contamination by flies. Quicker drying methods by mechanical means will have to be adopted to overcome these defects. Mechanisation will also have to be introduced in the preparation of laminated Bombay duck, a speciality product, which can find a better market in the overseas countries. The samples of Bombay duck carried by the Survey Team for exploring market opportunities in foreign countries have aroused interest in prospective buyers. They were keen to know more about the material and gave several suggestions to improve the quality of the products. The most important suggestion was about the cleaning of the fish before drying and on preventing the mixing of spoiled fishes with the good ones in the pack. The samples examined by the buyers and inspection laboratories contained on an average six to seven pieces of sub-standard quality in each packet. Deterioration was also manifested by the presence of foreign matter in some of the packets. All this indicates that modern processing methods will have to be introduced in the production of this valuable commodity for export. Processing plants will have to be established in one or two important production centres of Gujarat and Maharashtra coasts with facilities for hygienic production of the material. The present method of storing the finished consignments in ordinary godowns is undesirable and should give place to proper warehouses maintained at low temperatures.

Maintenance of Quality for Dried Prawns. Regarding dried prawn trade, improved techniques of production aimed at preparation of high quality material can still save the industry and sustain the markets in Burma, Singapore, Ceylon and other countries. If quality can be improved and maintained, it can also be possible to export this product to markets like Canada, USA, UK and France. The present method practised on cottage industry basis cannot ensure uniformity in quality. The products thus prepared generally seem to be not completely free from shell materials, broken pieces etc., and invariably contain sand and other insolubles as drying is done in the open. As demonstrated by CIFT it is possible to mechanise production even on small scale and prepare quality material devoid of the above defects. Here again separate warehousing facilities will have to be provided at least in Cochin, the main centre of export, for storage of the material until shipment.

2.5 Fishery By-Products

i) Fish Meal

In India the development of fish meal production has been very slow, the main reason being the non-availability of raw material sufficient to feed large scale units at a reasonably economic costs. Only five plants are in existence, one in Jaffrabad (Gujarat), one in Bombay having a capacity of 15 tonnes raw material per day, one in Malpe (Mysore) of 15 tonnes capacity, one in Calicut (Kerala) of less than 1 tonne capacity and one in Mandapam (Tamil Nadu) under the Indo-Norwegian Project of 50 tonnes capacity which has yet to go into production. The plant at Bombay is at present engaged in conversion of dried fish into fish meal. The Mandapam Plant aims at utilisation of sliver bellies caught around the Rameswaram Island.

A critical study reveals that the real problem is not one of non-availability of raw material itself but of difficulties in organising the collection of raw material at the points of production at comparatively cheap rates. At the current fishmeal prices in the international market, raw material should be available at Rs 100.00 per tonne or less to enable the producers to keep the cost of production within Rs 700.00 per tonne including processing, packing and freight charges. The following are the main sources of raw material:

i) Miscellaneous varieties of fishes like, silver bellies, sole, small jew fish, ribbon fish etc. landed by shrimp trawlers. It is estimated that not less than 20 per cent of the catch in all mechanised boats is composed of such cheap varieties of fish, which do not find a ready market. The price of these fishes generally ranges between Rs 100 and Rs 150 per tonne.

ii) Oil sardines are caught in large quantities during peak seasons. Their prices fluctuate between Rs 50 and Rs 120 per tonne. The annual landings of sardine are estimated at over 200,000 tonnes. Almost the entire quantity of this catch is at present utilised either as fresh fish or for the preparation of oil and guano, which can be used only as manure. The methods employed for preparation of guano are so crude that the product cannot go as fish meal.

iii) Wastes from fish freezing and canning plants. With the establishment of more processing plants, such waste is bound to be considerable, averaging between 25 and 40 per cent of the total quantity handled. The prawn processing units also have a sizable amount of waste in the form of heads and shells, approximately 20,000 tonnes annually which are found to contain on an average 30 per cent protein.

The smallest fish meal plant (Atlas) usually installed on shore is of 10-15 tonnes capacity per 24 hours. This requires a minimum space area of 6 x 5 x 2.5 metres and a separate boiler. Its steam requirements are of the order of 400-500 kgs/tonnes of R.M. with a working presssure of 6 kg/sq. cm, and the total installed power of 60 HP and above. These requirements restrict its installation on a fishing boat of size less than 60 metres. In view of this only such plants which require the minimum floor area, and lesser time for completion of the process can be installed on board. Plants offered by "Diez De Solland, S.A." Mexico appear to be suitable. Such a plant with a capacity of 25 tonnes of raw material per day requires a floor area of 14 sq. feet. The whole process in this plant is over in 6 seconds. An oil separate is provided as an additional accessory which can handle stick water for the recovery of oil. Heating is accomplished in it by use of exhaust gases from the engine room of the vessel. It is also light, weighing only 1.68 tonnes. Considering the fact that oil sardines constitute nearly 30 per cent of the total catch of marine fish in India, there is ample scope for the development of oil based industry.

Small commercial plants for shore establishment are now fabricated in India. A plant with a capacity of 10 tonnes of fish per shift is quoted at Rs 305,000 while another with 2 tonnes capacity is quoted at Rs 82,000.

Methods of Preparation. In the case of lean fish only drying and powdering will be sufficient for conversion into meal. However, fatty fishes have to be subjected to cooking and pressing to remove as much of the oil as possible before drying and powdering. It is generally found that fishmeal prepared from cannery waste is inferior in protein content than that prepared from fatty fishes. Here again the quality of the starting material is important in judging the quality of the final product. The material is to be preserved in ice until processed into fish meal.

Composition of Fish Meal. The following table gives the general composition of fish meal prepared from different varieties of fish that can be considered as possible raw materials:

Table B-20

Composition of Fish Meal in India

Fish	Yield %	Protein %	Fat %	P %	Ca (as % ash)
Caranx	14	63.08	8.23	12.81	10.0
Jew fish	14	69.47	6.62	7.20	9.4
Anchovies	15	71.34	4.50	4.90	7.4
Oil sardines	16	66.14	5.70	8.68	11.4
Miscellaneous	20	60.84	3.34	4.94	6.06
White bait	16.3	68.25	8.34	4.03	4.86
Ribbon fish	15.0	72.21	6.25	3.78	5.35
Soles	16.5	61.42	9.01	2.75	6.22

(All results on moisture free basis)

The analytical values indicate that all these fishes can yield products of fairly high protein values which can meet specifications in force. The official specifications adopted by the Ministry of Food and Agriculture (1959) are as follows:

Protein - 45% (min)
Moisture - 12% (max)
Insolubles - 7%
Fat - 7%
Salt - 7%
Size - 0.25 (particle size)

Utilisation of Prawn Waste

Prawn freezing and canning plants alone produce approximately 20,000 tonnes of waste in the form of prawn shells and heads. These are at present converted in part into dried powder to be used along with manure. However, greater proposition is wasted. Experiments have shown that prawn shells yield 10 per cent chitin and about 30 per cent protein. The oil extracted from the head portion is also found to yield cholesterol to the extent of 2.4 per cent of the oil. The chitin can further be converted into Glucosamine hydrochloride or Chitosans by adopting suitable methods. The composition of shell and head is given in Table B-21.

Table B-21

Composition of Prawn Shell and Head

	Head & Shell	Shell Only
Moisture	14.06	9.24
Ash % (MFB)	43.44	26.67
FAT % (MFB)	1.8	4.4
T.N. % (MFB)	8.33	9.85
Chitin N (MFB)	0.83	2.13
Prot. (MFB)	46.88	48.26
Chitin (MFB)	10.0	30.0
Ca. % of ash	14.03	13.4
P (P_2O_5) % of ash	3.51	3.73

Composition of feeds prepared from prawn shell powder and sardine meal in 60:40 proportion.

It has been found that prawn shell powder, if suitably mixed with sardine meal, can give a balanced chick feed. The analytical characteristics of such feeds are given below:

Moisture %	7.5
Ash %	20.85
Fat %	4.11
T.N.	9.59

Protein %	54.77
P %	2.46
Ca %	6.8
Digestibility %	87.36

Most of the above findings are on laboratory scale. All products except poultry feed have to be tried on a pilot scale before recommending to the industry for large scale production. A pilot plant is estimated to cost about Rs 100,000.

Fish Ensilage

A very cheap and efficient method for the preservation of waste fish in liquid form has been worked out. The method consists in mincing the fish in the whole form, mixing it with 20 per cent of weight of molasses as a source of carbohydrate and 20 per cent water into a slurry. An inoculim of Lacto-bacillus is introduced into the slurry, and is kept covered in a wooden container. Fermentation is complete within 14 days during which the pH of the slurry drops to 4.5. The yield from a tonne of raw material is found to be 1.40 tonnes. The fishery smell is almost completely removed and product remains in good condition for several years if packed airtight. The fresh product analyses are as given in overleaf.

Table B-22

Composition of Fish Ensilage from Different Varieties of Fish

			Silver Belly	
	Cooked ensiled	Uncooked ensiled	Cooked	Uncooked
T.N. mg%	1940	1920	1760	1790
W.S.N. mg%	420	1020	540	990
NPN mg%	180	460	201	390
L-NH_3N mg%	162	170	79	129
S.V.N. % of T.N.	8	19	8	18

The method is in the final stage and can readily be recommended to the trade. The most expensive item in the production is molasses which is priced at Rs 8 per kg (one tonne of raw material requiring approximately 200 kg molasses).

Fish oil

Fish oils can be divided into two categories viz. fish liver oil which is rich in vitamins and fish body oils. The main sources of liver oil are the sharks, skates and rays, the latter two yielding oils comparatively poor in Vitamin D. With increase in shark fishery for freezing there will be corresponding increase in liver oil manufacture also.

India's main source of raw material for fish body oil is the oil sardine. With a rich fishery amounting to an average of more than 200,000 tonnes of fish every year it should be possible to expand production of the oil. Studies have revealed that almost throughout the year sardines give a high oil content the maximum being 17 per cent in November and the minimum 2 per cent in certain months. It is further known (exact statistics are not available) that about 50 per cent of the total landings of sardine are used for preparation of oil. Assuming an average of 12 per cent oil content, this would work out to an annual production of roughly 300 tonnes fish oil. Such a low yield is found to have been the result of faulty techniques of the extraction.

Improved methods have recently been suggested for the efficient extraction of oil and it is expected that the yield will improve to the expected level if extraction is organised in selected centres. The methods also ensure higher quality of the oil. Good quality oil has direct application in the leather industry which is at present importing over 200 tonnes of animal oil. Export figures below indicate that small quantities of fish oil are being exported from the country since 1965:

Table B-23

Exports of Fish Oil from India

	Quantity (tonnes)	Value (Rupees)
1965	69	66,000
1966	49	60,000
1967	50	73,000

There is scope for increasing this export if quality oil can be prepared as suggested above.

Recent studies conducted in CIFT also indicated that sardine body oil can be used for the preparation of a variety of useful industrial products such as factice (rubber filling compound), water repellant paints, printing ink and lubricating oil additive. The approximate costs of production of sardine oil and other products on laboratory scale based on oil price at Rs 1.25 per kilo are given in Table B-24.

Table B-24

Cost of Production of Sardine Oil and Meal and Other Products

(i) Sardine Oil

Cost of oil sardines per 100 kg.	Rs 20.00
Quantity of oil available from 100 kg	12 kg.
Quantity of meal available from 100 kg	13 kg.

Extraction by Steam Heating and Artificial Drying

Cost of steam for cooking @ Rs 10 per 1000 kg. (Total steam 50 kg).	Rs 00.50
Cost of steam for drying	Re. 1.00
Cost of electricity and water	Rs 1.50
Depreciation etc.	Rs 0.50
Labour	Rs 2.00
Total	Rs 25.50
Cost of fish meal @ Rs 699 per tonne	Rs 10.80
Cost of 12 kg. oil	Rs 14.70
Cost of oil per kg.	Rs 1.22

By using Fire Wood and Sun Drying

Cost of 100 kg. Sardines	Rs 20.00
Cost of fire wood (50 kg. @ Rs 30 per tonne)	Rs 1.50
Labour	Re. 1.00
Total	Rs 22.50
Cost of fish meal @ Rs 550 per tonne	Rs 9.90
Cost of 12 kg. oil	Rs 12.60
Cost of oil per kg.	Rs 1.05

ii) Factice

Cost of sardine oil 50 kg.	Rs 62.50
Cost of sulphur 9 kg.	Rs 28.00
Electricity	Rs 10.00
Labour	Rs 13.00
Yield of factice	56.5 kg.
Cost of production per kg.	Rs 2.50

iii) Printing Ink

Cost of Stearine separated sardine oil 50 kg.	Rs100.00
Cost of sulphur	Rs 2.00
Electricity	Rs 25.00
Additives	Rs100.00
Pigment	Rs200.00
Labour	Rs 25.00
Misc.	Rs 25.00
Packing	Rs 80.00
Total	Rs557.00

Yield 80 kg.	
Cost of ink per kg.	Rs 6.96

iv) Surface Coating Material

Stearine separated sardine oil 50 kg.	Rs 100.00
Additives	Rs 50.00
Resin	Rs 25.00
Pigment	Rs 100.00
Drier, dispersing agents etc.	Rs 50.00
Solvent	Rs 62.00
Packing	Rs 62.00

Labour		Rs 15.00
Misc.		Rs 5.00
	Total	Rs 470.00
Yield 67 kg.		
Cost per kg.		Rs 6.25

Apart from the possibilities of using sardine oil for the preparation of the above there is also the direct use of the oil in packing of sardine in cans. Studies have shown that the refined oil prepared by the improved method is very suitable for canning sardines. One tonne of oil costing Rs 1,250 at source will be sufficient for 500 cases of 100 cans each of quarter dingley cans. Groundnut oil which is at present used for canning sardine costs a minimum of Rs 3,960 per tonne. Use of sardine oil of good quality in canning of sardine is thus found to substantially reduce the cost of production which may help export of this commodity.

Fish Maws and Shark Fins

Fish maws and shark fins are two items which have a potential export market. Exports of these items from India have been substantial as revealed in Table B-25.

Table B-25

Export Figures for Fish Maws and Shark Fins

	Quantity (tonnes)	Value (Rupees)
1960	298	2.07
1961	292	2.22
1962	349	3.44
1963	341	3.05
1964	378	2.83
1965	244	2.03
1966	139	1.34
1967	295	3.71

It has however been reported that these items exported from India do not fetch maximum ruling market prices owing to inconsistency in quality and grading.

Fish Maws. These are dried fish air bladders attached to the backbone of some fresh water and marine fishes. Dara, jew fish, catfishes and eels are the varieties of Indian fishes which yield good quality air bladders. Generally the following three methods are employed for this preparation.

i) The air bladders removed from the fish are dried in the sun after washing in water till they become hard.

ii) The air bladders are cut open and the internal membranes are taken out. These are then washed well till they are free from blood and memrane in fresh water and beaten against wood till fully flattened.

iii) The air bladders are pulled into shreds by hand, dusted with lime and dried in the sun.

A good quality product is white in colour, semi-transparent and tough. Yellowish colouration indicates inferior quality of the starting material and improper cleaning.

Shark Fins. The spine and fins from big sharks of about 5 ft. or more in length are cut and freed from adhering flesh and washed well. The fins are dusted with salt in the ratio 1:10 (Alternatively the cut portions are smeared with a little lime and salt) and set aside for 24 hours. At the end of the period the fins are dried in the sun to a moisture content of about 7-8 per cent.

The dried fins are graded according to colour, size and species and packed in moisture proof containers (polythene lined wooden boxes or gunny bags).

Preparation of Fin Rays. A more sophisticated method of utilisation of shark fins for export purposes is to convert it into fin rays. For this the dried fins are initially soaked in water acidified to pH 2.5-5.0 with acetic acid for 5 to 6 days, by which time the muscle and skin of the fins get softened. The softened muscle and skin are scrapped off by a sharp knife and the rays are washed well. The cleaned rays are dried either in the sun or in an artificial dryer at 35°C to 45°C to a moisture content of 5-8 per cent. The dried material can be stored in polythene lined gunny bags or in any other suitable containers.

A simpler method is to cook the dried shark fin in acidified water until all the collagen is hydrolysed. to gelatin. The rays are picked -- up freed from adhering muscle, washed and dried.

Fish Protein Concentrate

Preparation of edible fish flour (fish protein concentrate) from waste fish has been recommended as one of the easiest methods to combat protein malnutrition in under nourished countries. Various methods, most of which are based on solvent extraction techniques are employed for production of FPC.

Solvents like Ethylene dichloride (Viobin process), isoprophyl alcohol (Canadian method and US - Bureau of Com. Fisheries) ethyl alcohol (Denmark, Mysore) Hexane and alcohol (MIT-UNICEF Process) etc. have been used. Recently a simplified process has been worked out by the CIFT based on the MIT-UNICEF process. In this an azeotropic mixture of hexana and alcohol are made use of in the extraction in a single stage instead of double extraction followed in the original process. The details of the modified process are as follows:

The fish after mincing is suspended in equal amount of water to which is added 0.5 per cent acetic acid and kept at 70-80°C for 30 minutes under constant stirring. The slurry is filtered and pressed in a screw press. The press cake is then dried in a tunnel dryer at a temperature of 75 to 80°C. The dry matter is ground to a coarse powder. The powdered material is charged into an extraction drum having arrangements for constant stirring. An azeotropic mixture of hexane and alcohol (B.P. 58-68°C) is added in 2½:1(V/W) proportion and kept at the boiling temperature for 30 minutes. The solvent is drained off and fresh solvent added in 1:5:1 (V/W) proportion and stirred for another 30 minutes. After final draining the process is repeated once again and drained. The adhering solvent is removed by steam stripping under reduced pressure. The dried matter is pulverized to a fine mesh. Analytical characteristics of FPC compared from different varieties of trash fish are summarised in the following table:

Table B-26

Composition of Fish Protein Concentrate from Trash Fish

	Moist %	Ash %	Residual fat %	Protein %	Pepsin digestibility %	Available lysine g/16 g.N.
Muscle alone	7.16	6.48	0.26	84.87	96.6	8.73
Dressed fish	7.15	21.03	0.38	72.64	94.1	7.81
Dressed Misc. fish	7.50	18.11	0.24	73.17	94.5	7.84
Flour from meat of mixed varieties	6.94	4.78	0.54	87.50	95.9	8.12
Flour from whole fish (wet extraction)	7.22	23.11	0.51	68.24	93.4	7.51

Cost of Production. Based on the laboratory studies an approximate cost estimate has been prepared for plants of capacity 5 and 50 tonnes, raw material per day. Capital investment works out to ₨ 0.8 million and ₨ 6.6 million respectively and the final cost of the finished product works out to about Rs 3,800 and Rs 3,700 per tonne respectively based on a raw material cost of Rs 400 per tonne. The method has been perfected only on laboratory scale. The design for a pilot plant capable of handling 100 kg. has been evolved and is under construction. The pilot plant is estimated to cost about Rs 130,000. All the components of the plant and solvents are available within the country and hence there is no need for import.

Commercial Uses of FPC. Export potentialities of the product are not known. There may be difficulties in directly utilising the product for human consumption. However, the product can be incorporated into bread, biscuits etc. or converted into baby food preparations.

Bacteriological Peptone from Trash Fish

A new use, preparation of bacteriological peptone, has recently been found for trash fish. The country's requirements of bacteriological peptone are at present met by imports and the retail sale price of Difco peptone is Rs 120 per lb. The method worked out for the preparation of this product from trash fish is as follows.

The washed fish is dressed and the meat separated. The meat is washed again and boiled with equal quantity of water containing 0.5 per cent (W/V) of acetic acid for 30 minutes. The material is pressed in a screw press. The press cake is extracted with acetone in a continuous extractor until the fat is completely removed. The extracted cake is boiled with equal quantity of water for 30 minutes making up the water lost during boiling. The temperature is brought down to 40°C. About 0.5 per cent (on the basis of the weight of dressed fish) casein is added, the pH adjusted to 7 and 0.15 per cent papain is added. The material is scaled in the container with a layer of Tolurine and incubated at 40°C for 12 hours.

Cost of Production

	(Per kg. finished product)
Cost of raw material at 0.25 P/kg.	Rs 10.00
Solvent	Rs 8.00
Casein	Rs 4.00
Processing cost including dressing, extraction, drying	Rs 5.00
Cost of enzyme	Rs 6.00
Total	Rs 33.00

At the end of the period it is boiled to stop enzyme action. The undigested portion is filtered off and the filtrate readjusted to pH 7.2. It is concentrated to a semi-solid consistency and then dried at 60°C under vacuum. The product thus prepared has been exhaustively tested for efficiency and has been found comparable to imported Fifco petone.

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